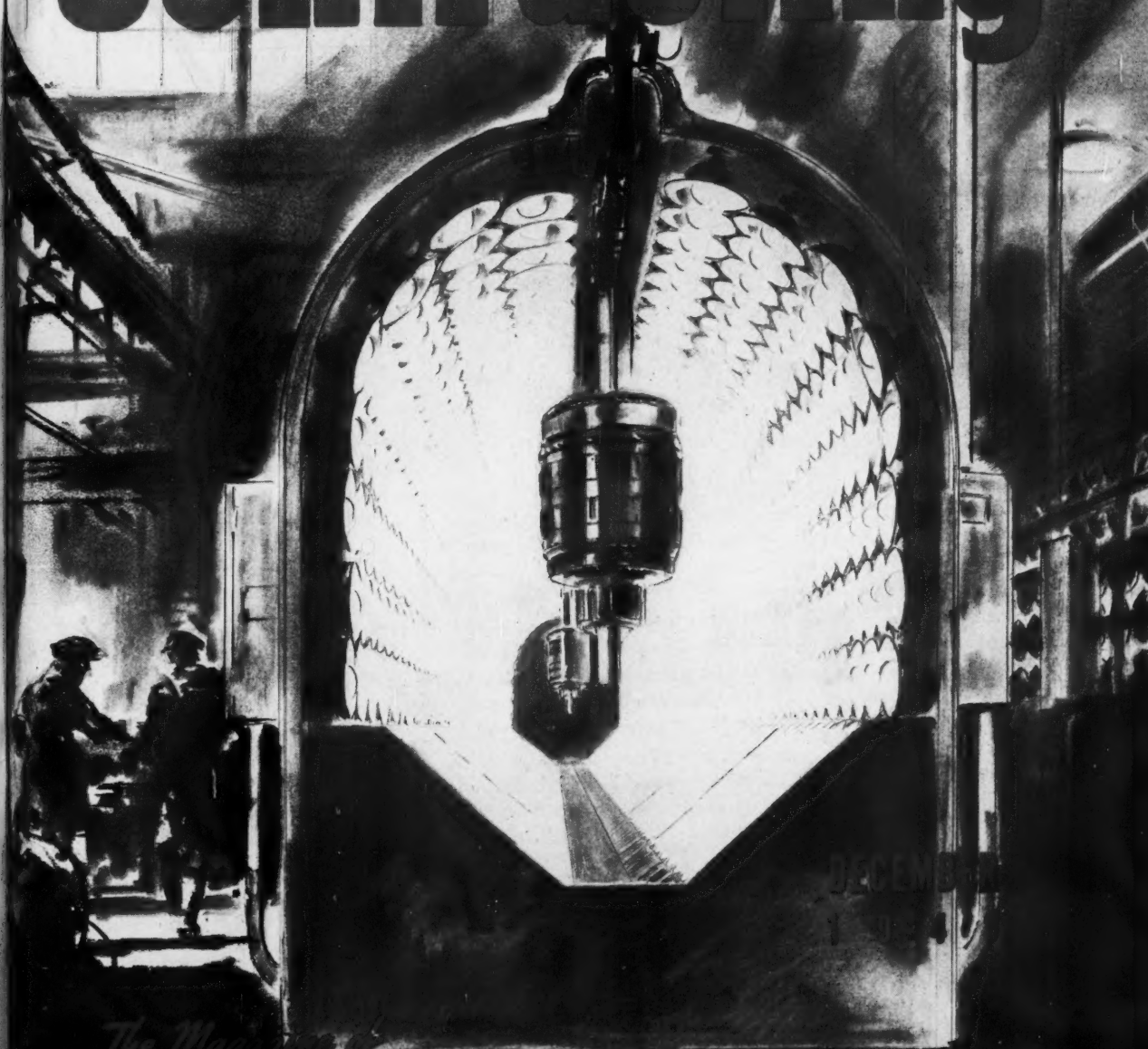


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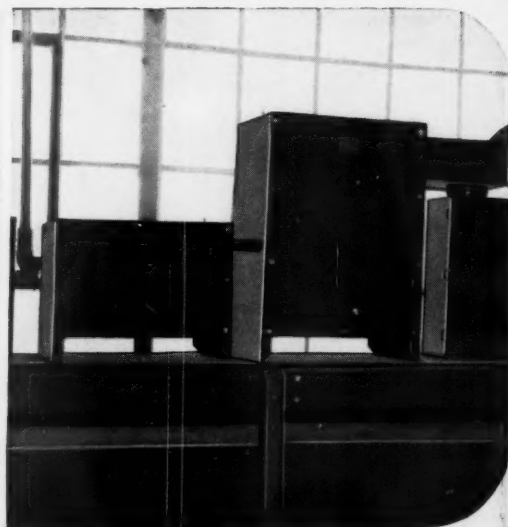
Electrical Contracting



The Magazine of

ELECTRICAL CONSTRUCTION AND MAINTENANCE

- ★ Saved critical material, time, labor, money—by eliminating the need for extensive rewiring.
- ★ Reduced the load demand of the plant's electric system more than one third.
- ★ Improved voltage regulation throughout the entire plant, and decreased the load on the feeders.
- ★ Reduced the power cost
- ★ Made possible greater production



One of the three Pyranol capacitor installations at Gate City Iron Works that made available more power for welding, motors, and plant lighting.

WHAT CAPACITORS DID for the Gate City Iron Works

THEY CAN DO FOR YOU

WHEN the Gate City Iron Works in Omaha, Nebraska, needed additional capacity for greatly increased welding operations, they got it by improving power factor by means of Pyranol capacitors. Three 240-kva units did the job, with the results listed above.

If your plant's power system is fully loaded—or overloaded—and is operating at low power factor, capacitors can help you, too. They supply reactive kva that otherwise has to travel through your transformers and feeders, and thus your plant wiring can carry more working current—as much as 40 per cent in some cases.

Remember, too, a capacitor installation can be made in a matter of weeks instead of the months necessary with other methods. Ask your G-E representative to estimate the possible increase in your circuit capacity, or write for Bulletin GEA-77. *General Electric Company, Schenectady, N. Y.*

The best investment in the world is in this country's future—BUY WAR BONDS



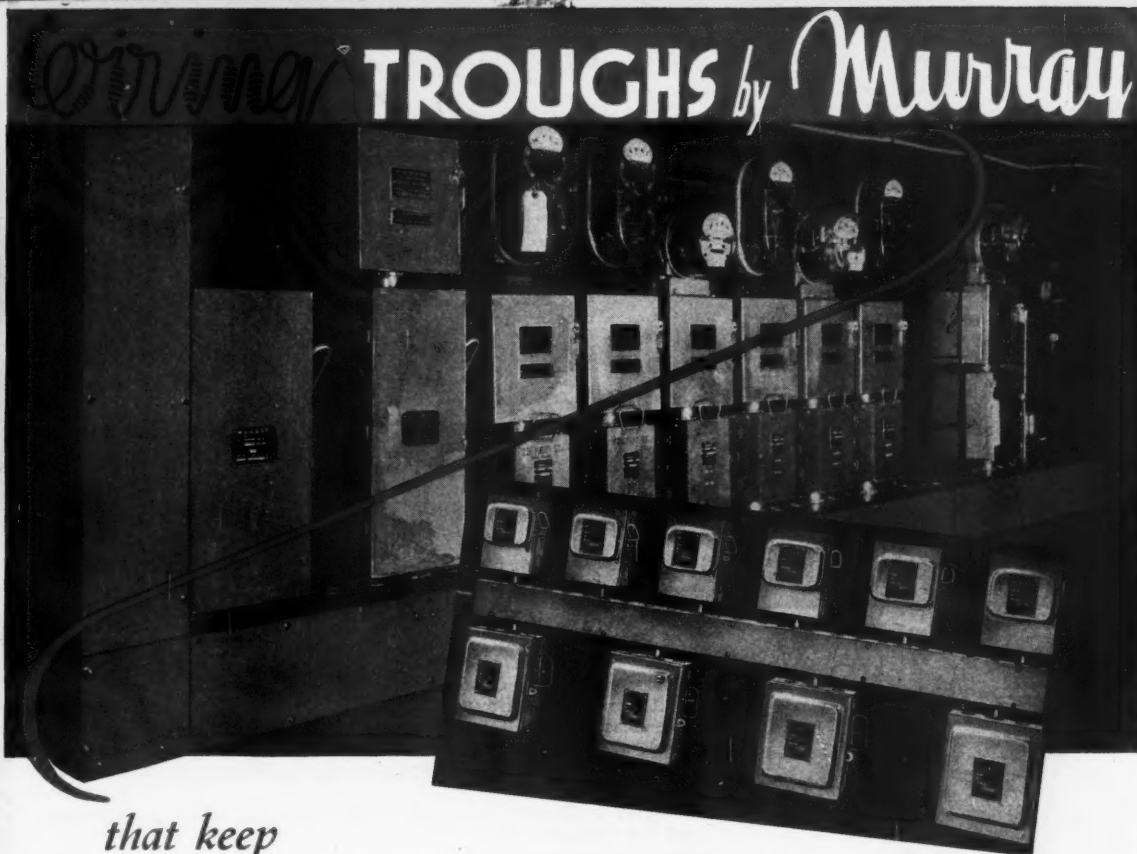
PYRANOL CAPACITORS

GENERAL  ELECTRIC

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that keep
the
TOUGHEST
"GANGS"
in line

No matter how complicated, how long or how many turns (ever-ready elbows do the trick), Murray Wiring Troughs are easy and quick to install. They are strong and rigid when in place, yet easy to get into, through instantly removable covers. Tap for a branch anywhere—always a knockout handy. Four lengths—and four depth-width combinations. The installations above are typical—and the first you put in will look just as ship-shape and prove the easiest job you can remember. Metropolitan Device Corporation, Brooklyn, N. Y.



Murray
WIRING TROUGHS for "ganging"

Metropolitan Device Corp.
Brooklyn, N. Y.

Please send catalog of
Murray Wiring Troughs.

Name _____
Company _____
Address _____

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"Appleton Fittings"

GIVE US ALL THREE

1

SUPERIOR DESIGN
AND WORKMANSHIP

2

COMPLETENESS
OF LINE

3

PROMPT
SERVICE

FORM 35
THREADED
"UNILET"



FORM 35
NO-THREAD
"UNILET"



Any way you look at it—on *all three* of the important factors in selection of electrical fittings—*Appleton scores!* Specify Appleton outlet and switch boxes and conduit fittings, and you're sure to get what's needed—you can depend on Appleton's forty years of leadership for skilled engineering, practical design and careful workmanship—you can expect, *and get*, deliveries where and when you want them!

Form 35 Unilets, illustrated here, are typical of the superiority of the COMPLETE APPLETON LINE! Design is modern and clean cut, down to the finest detail; light, strong *malleable iron* castings are smooth, free from gating marks and are unbreakable, even under extreme temperature variation. Wiring spaces are roomy; all hubs have chamfered edges assuring straight, accurate tapping. All Form 35 Unilets are free from sharp or rough edges which might cut insulation.

Whatever your fitting requirements, save your own time and energy — make jobs run smoother — specify APPLETON — "Standard for Better Wiring!"

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QUICK ADAPTERS MULTIPLY UTILITY



Any Form 35 Threaded Unilet, designed for heavy-wall conduit, may be quickly adapted for use with electrical metallic tubing by means of Adapter shown at left.



SHARP 90-DEGREE BENDS MADE SAFE AND EASY

For 1/2- to 6-inch conduit, inclusive.



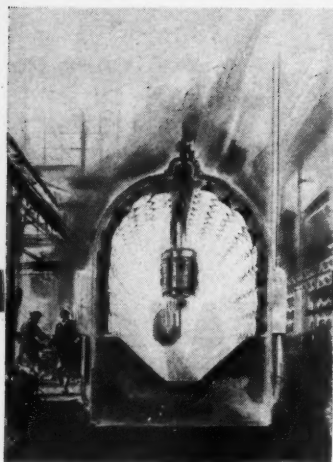
Smoothly rounded edges protect insulation when conductors are pulled

Type "LBD," Form 35 Unilet specially designed to make sharp 90-degree junctions, with a straight, easy pull both ways. Smooth dome cover and smoothly rounded edges on cover opening insure against injury to insulation in pulling wires. A practical Appleton feature.



A P P L E T O N

CONDUIT FITTINGS • OUTLETS AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES



OUR COVER this month is "Radiant Heat in Industry", the fourth in a series of original sketches of electrical equipment in wartime by Artist Stephen Grout.

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A practical technical and management journal for electrical contractors, industrial electricians, inspection engineers and motor men, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

Electrical Contracting

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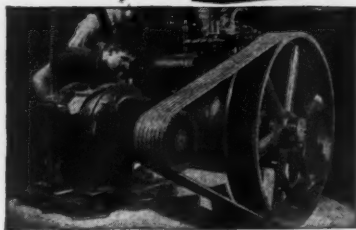
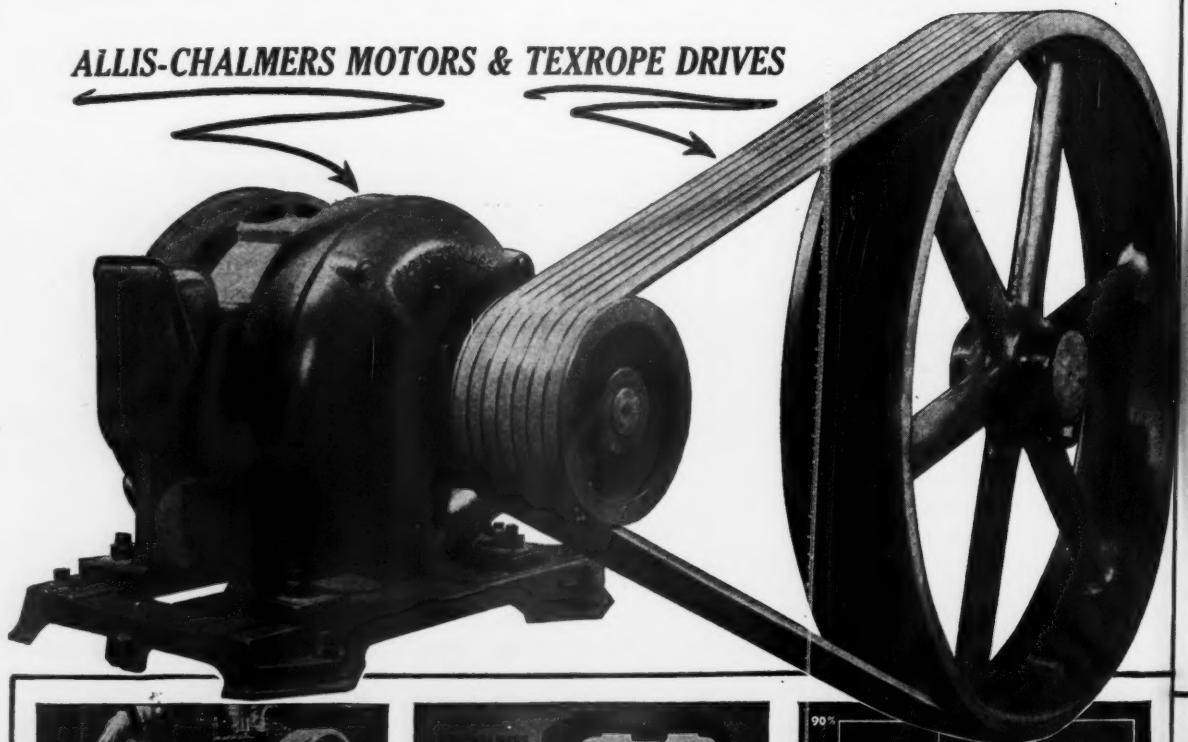
Electronic Motor Drive.

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Here's the Team New Power

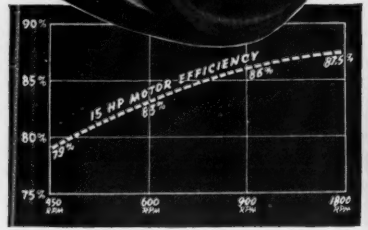
ALLIS-CHALMERS MOTORS & TEXROPE DRIVES



1 In most applications, an 1800 rpm motor with Texrope Drive will ably do the job of a lower-speed, direct-connected motor—at lower cost in money and materials!



2 When you buy an 1800 rpm instead of 450 rpm 15 hp squirrel-cage motor, for example, 600 lb are saved. And you save well over \$200—with drive figured in!



3 Note that efficiency rises from 79% for the 450 rpm motor to 87.5% for the 1800 rpm motor. The 1800 rpm motor saves you over 30 kw/24 hr. day.



ALLIS-CH

to Solve These Problems!

1. HOW TO DRIVE LOW SPEED MACHINERY WITH HIGH SPEED MOTORS? Allis-Chalmers Texrope Drives can "gear down" motor speeds over a range of 7 to 1. They're compact, highly efficient, protect your equipment by absorbing shock.

2. HOW TO DRIVE A MACHINE AT DIFFERENT RATES WITH A SINGLE SPEED MOTOR? Texrope Adjustable-Speed Drives give you infinite speed range up to 375%. And in Allis-Chalmers' full line of Texrope Drive equipment you'll find the *right* range for your machines . . . thus avoid paying extra for more speed than you need.

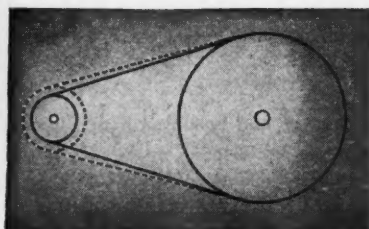
NOW THAT low-speed and multi-speed motors are sharply restricted, get the *flexibility* you need by teaming up available types of Allis-Chalmers Lo-Maintenance Motors with Texrope Drives.

As America's only builder of *both* motors and V-belt drives, Allis-Chalmers has long studied and

advocated their use in proper combination. Today, you benefit from Allis-Chalmers pioneering when you ask for—and get—the *right* combination of Lo-Maintenance Motor and Texrope Drive.

Call on any A-C district office or write to ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

A1647



4 Infrequently needed speed changes can be had by changing from one size motor sheave to another. Juggling *complete* drives, range is 1:1 to 7:1.



5 With the Allis-Chalmers Vari-Pitch Sheave, you can increase or decrease speed by adjusting sheave diameter . . . obtaining an *unbroken* series of speeds!



6 Allis-Chalmers Vari-Pitch Speed Changer gives you infinite changes at the turn of a wheel — within 3.75 to 1. It's compact, flexible, *efficient*!

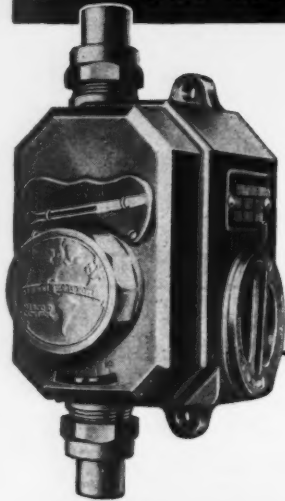
ALLIS-CHALMERS

**LO-MAINTENANCE MOTORS
TEXROPE DRIVES**

CROUSE-HINDS Thermostat Condulets

For Heating, Air Conditioning, Refrigeration

FOR HAZARDOUS LOCATIONS



Explosion-Proof and Dust-Tight—

Suitable for use in atmospheres containing ethyl ether vapor; gasoline, naphtha, petroleum, benzol, alcohols, acetone, lacquer solvent vapors and natural gas; metal dust; carbon black, coal or coke dust; grain dust; combustible fibers.

Type HRC

Mercury tube switch.

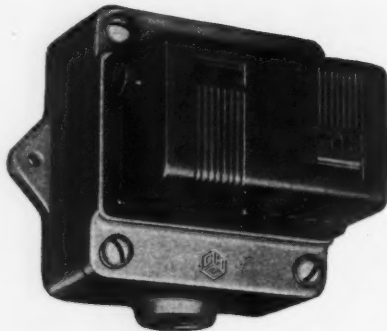
Threaded flame-tight cover.

Through feed ½-inch union hubs. Either hub can be capped.

Accurate thermometer for indicating room temperature.

Locking arrangement can be furnished to prevent regulating by unauthorized persons.

Listed in Condulet Catalog No. 2500, Section 85, Page 50-3.



Type HR

Contactor snap switch.

Ground surface flame-tight cover.

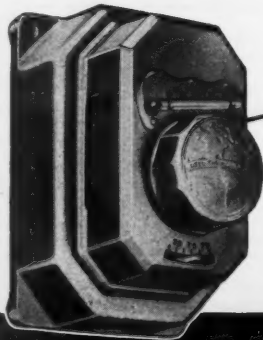
Reversible. ¾-inch hub can be at top, bottom, or either side.

Accurate thermometer for indicating room temperature.

Regulating knob removable to prevent unauthorized regulating.

Listed in Condulet Catalog No. 2500, Section 85, Page 50-4.

FOR NON-HAZARDOUS LOCATIONS



Type FHRC

Mercury tube switch.

Through feed ¾-inch hubs flush with top and bottom of body. Removable plug for either hub.

Accurate thermometer for indicating room temperature.

Locking arrangement can be furnished so thermostat can only be regulated by authorized persons.

Listed in Condulet Catalog No. 2500, Section 50, Page 22B.

CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U.S.A.

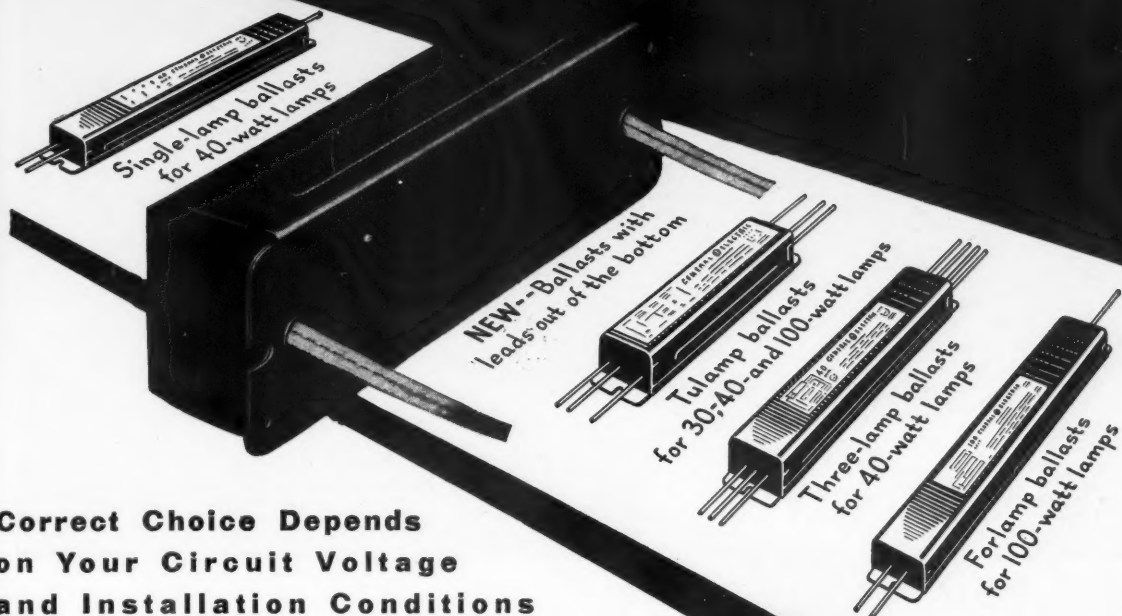
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For War-plant Fluorescent Lighting CHOOSE THE G-E BALLAST THAT WILL



Correct Choice Depends on Your Circuit Voltage and Installation Conditions

Single-lamp ballasts—The natural choice for installations requiring but one lamp per fixture; used most often in restricted spaces or where low levels of illumination are sufficient.

Tulamp ballasts—Available for all lamp ratings from 15 watts to 100 watts; conserve materials in the ballast, reduce light "flicker," cut electrical losses, require fewer fixtures for a given-sized installation.

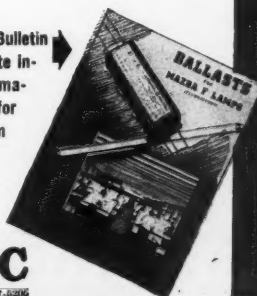
Three-lamp ballasts—Designed for use with 40-watt lamps on all circuits. You avoid use of two ballasts in one fixture, simplifying installations and saving materials.

Forlamp ballasts—For use with 100-watt lamps on 265/460Y-volt circuits; a "natural" for war-plant lighting; does the work of two Tulamp ballasts of the same rating, yet is the same physical size; in one aircraft factory

installation, the use of Forlamp ballasts instead of Tulamp saved enough copper to make 95,000 cartridge casings (20-mm) and enough aluminum to make 111,000 fuse primers.

Ballasts with leads out the bottom—The most recent addition to the G-E line; available in 40-watt Tulamp and three-lamp ratings, 100-watt Tulamp and Forlamp ratings; developed as an aid to fixture manufacturers in saving critical materials; can be mounted completely exposed atop a shallow wiring channel.

WRITE TODAY for Bulletin GEA-3293 for complete information on G.E.'s material-saving ballasts for MAZDA F lamps from 4 to 100 watts. General Electric Company, Schenectady, New York.



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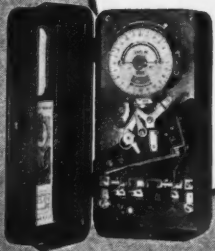


**BALLASTS FOR
FLUORESCENT
LIGHTING**

NEVER A MISTAKE WHEN PROTECTIVE FLOODLIGHTING IS
Automatically Controlled



**YOU HAVE A
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 WITH
 SANGAMO
 TIME SWITCHES
 in Selling the
 AUTOMATIC
 CONTROL
 IDEA.....**



DURING BLACKOUTS

During any current interruptions, as for instance when a master switch is pulled for a temporary blackout, Form YSWZ Astronomic Dial Time

Switch will continue to run for ten hours. An automatic carry-over feature provides for clock-spring operation when the current is off. The clock-spring rewinds automatically when the current is restored, and the time switch resumes its normal synchronous operation.

Sell Sangamo Time Switches right along with those protective floodlighting installations. This addition of automatic control makes each installation fully dependable—the kind of assurance all vital properties serving in the war effort must have. Contrary to human traits, a Sangamo Time Switch never errs—therefore, the lights go on and off as required. There are numerous types of Sangamo Time Switches so that every protective lighting control need can be fully met. The complete line includes Astronomic Dial, Synchronous Carry-over, and Outdoor Time Switches. Our catalog describes them.



SANGAMO ELECTRIC COMPANY **SPRINGFIELD ILLINOIS**

KEEP THIS LIGHT ALIVE...

**By Maintaining
Plant Efficiency
Through**



ALIVE...



● Today . . . TONIGHT . . . with the United Nations on the attack . . . it is more important than ever to keep the flood of war goods rolling off the production lines. And foremost among plant efficiency "musts" is *good lighting*, for efficient seeing to banish eye strain and fatigue . . . two conditions to which the *older* workmen of today are especially susceptible.

To be sure of getting industrial lighting fixtures that can meet the severe service conditions of a month-in, month-out 24-hour war production schedule . . . specify RLM certified lighting units . . . identified by the RLM Label. RLM Certified Lighting Units are built to rigid specifications developed by RLM Standards Institute. Strict and continuous inspection by Electrical



The RLM Label has stood as a sign of quality in industrial lighting for more than 20 years.

Testing Laboratories assures conformity to RLM Specifications by all manufacturers of RLM Labeled Industrial Lighting Units.

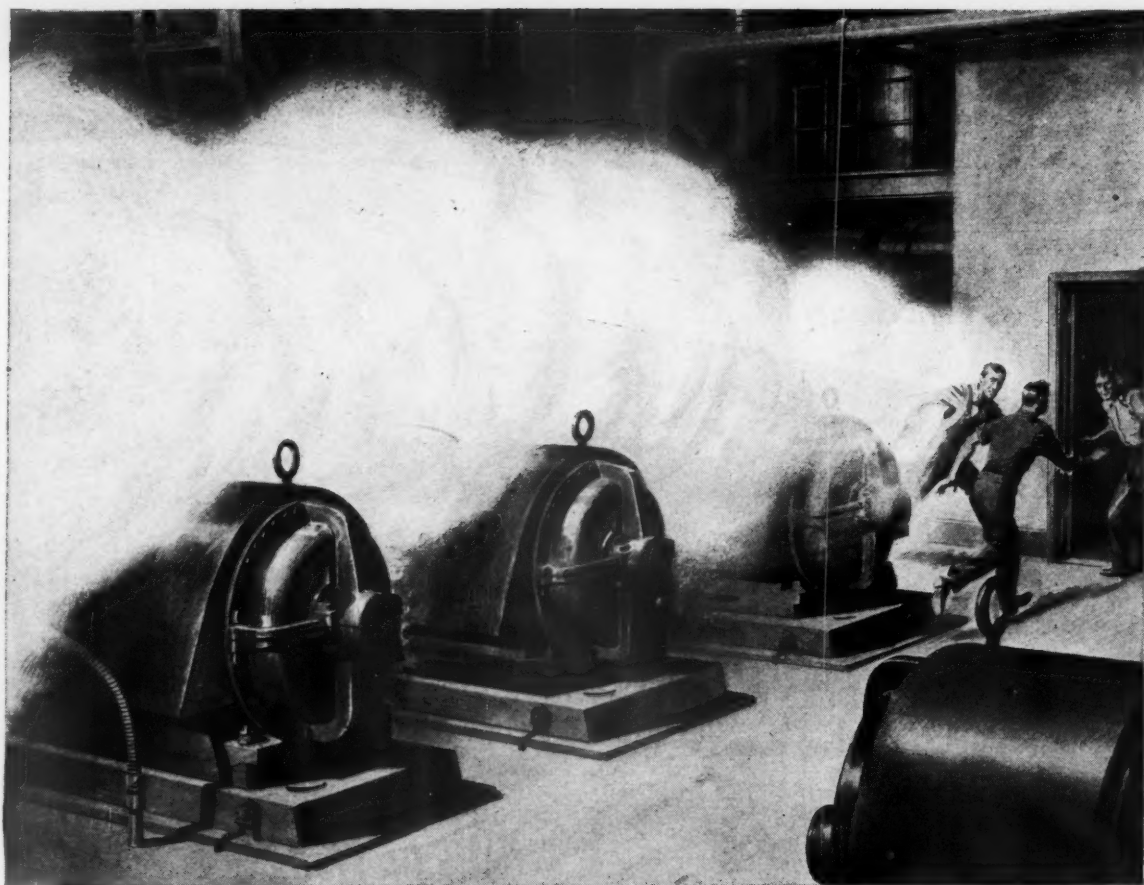
For full particulars, write any manufacturer or distributor of RLM Industrial Lighting Units, or to the RLM Standards Institute.

The Letters RLM Stand for Reflector and Lighting Equipment Manufacturers

RLM STANDARDS INSTITUTE
INCORPORATED

SUITE 1400, 307 N. MICHIGAN AVENUE

CHICAGO, ILLINOIS



Why the engineer was only partly right

THE SUPERINTENDENT of the power station was examining his monthly report.

"Pretty good record of performance," he said to himself.

Certainly, local war plants had increased their demands for power, but to date all their requirements had been met . . .

Suddenly, a roar followed by a tremendous hissing sound came from the vicinity of the steam generator plant. The superintendent dashed from his office.

When he reached the power plant, live steam was pouring into the boiler room. This room contained six 700 H.P. induction motors to supply air for the main boilers.

"It looks bad," shouted an assistant engineer. "They're turning off the steam, but the motors can't take that kind of heat."

But, the story doesn't end there. It later developed that the engineer was

only partly right. Only four of the motors failed. The other two were able to keep the plant in operation, at reduced capacity, because these two motors had previously been wound with Fiberglas* Electrical Insulation.

* * *

Here is an actual instance of the superior heat-and-moisture resistance of Fiberglas Electrical Insulation.

This insulation, used with proper impregnant is also proving its ability to withstand high temperatures caused by today's severe overloading of motor and generator.

Serving the Services

These are some of the reasons why Fiberglas Electrical Insulation is being so widely used today by the Army and the Navy and War industries for many types of motors, generators and transformers . . . for wire and cable in planes, tanks, and ships.

As the production of Fiberglas Insu-

tion is being constantly increased, more and more of this material is becoming available for more applications.

Ask your electrical distributor for technical data on Fiberglas Electrical Insulation and about its availability for your use. Or write: *Owens-Corning Fiberglas Corporation, Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

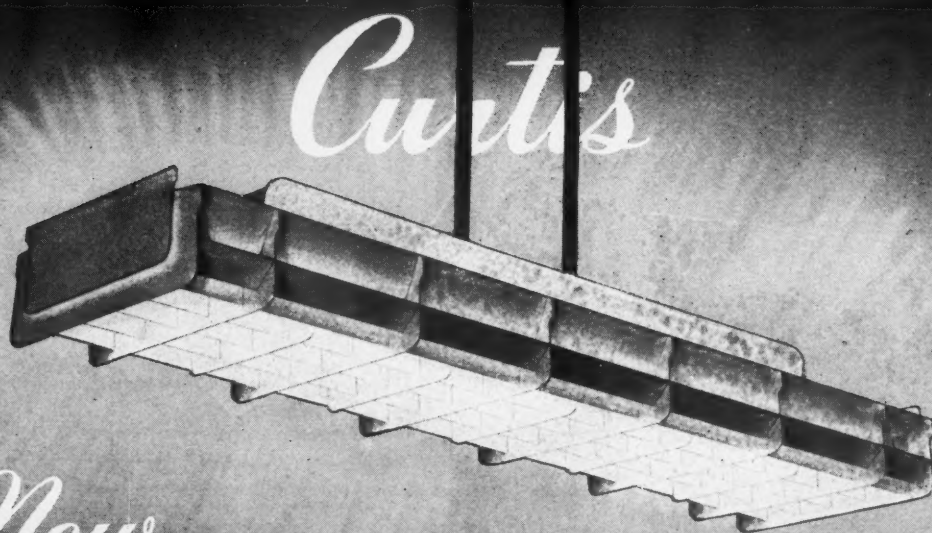


FIBERGLAS

*T. M. Reg. U.S. Pat. Off.

ELECTRICAL INSULATIONS

Electrical Contracting, December 1943



Curtis

New "WARRIOR"

A NON-METALLIC FLUORESCENT UNIT *for Offices and Drafting Rooms*

Here's a unit with typical Curtis character . . . a touch of modern functional design . . . Easy to install . . . either single pendant or single ceiling mounted . . . perfect for continuous lines . . . High in efficiency and low in maintenance expense . . . Metal channel of the unit well within government limitations . . . louver and reflector made of less critical materials . . . finished in Curtis "Fluratex."

Let the Curtis "Warrior" help you sell your next lighting job.



We are proud to have been awarded the Maritime "M" for outstanding achievement in the production of war material.

SPECIFICATIONS

DIMENSIONS: Single section, 48 $\frac{1}{4}$ " long. Continuous run adds 48 $\frac{1}{4}$ " per section. Shielding angle of louver is 45° crosswise and 30° lengthwise, satisfying office lighting specifications.

MAINTENANCE: The louver assembly comprising bottom, sides and ends assembled in one unit. Releasing two spring catches on either side of the fixture permits it to hinge from the remaining two spring catches, for cleaning and lamp replacement. Complete assembly removed from channel by releasing all four catches.

The reflector is removed by releasing four wing nuts. Starters are located on top of the fixture channel and may be reached without removing any other fixture parts.

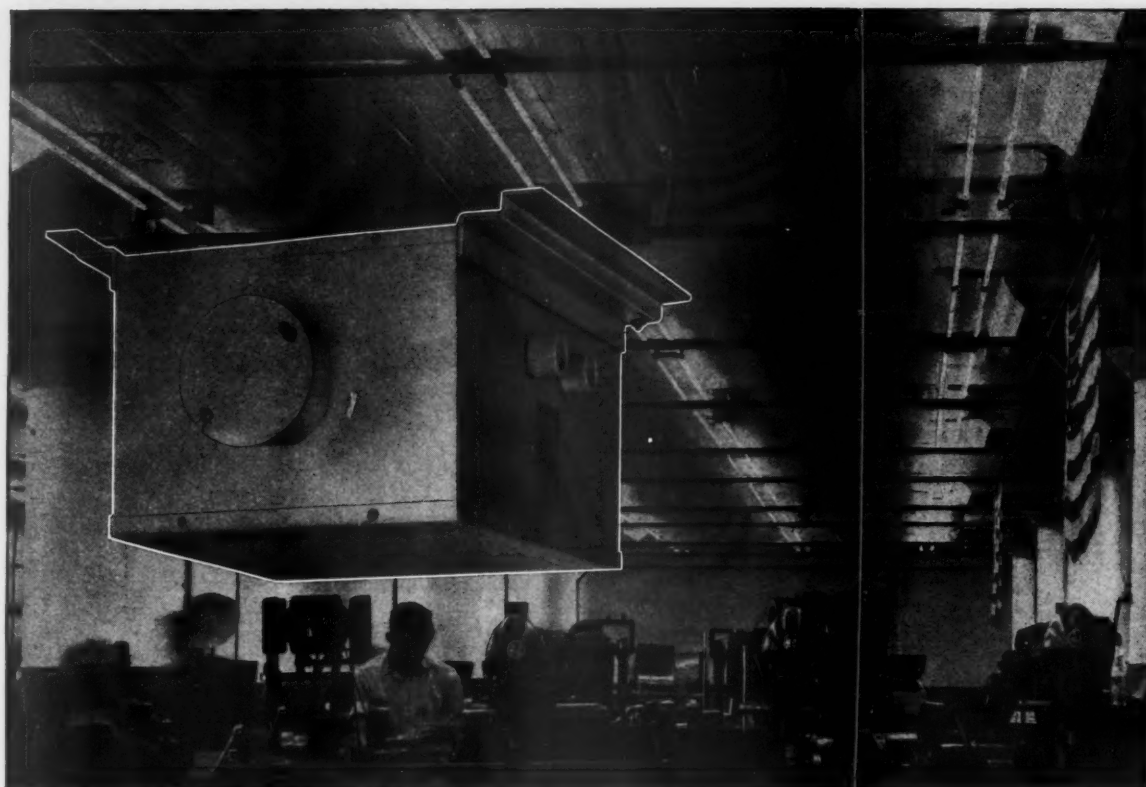
MATERIAL: Steel channel. "Fluratex" non-metallic louver body.

FINISH: Steel channel finished light gray. Louver body, ballast shields, and reflector are finished Fluracite.

WATTAGE: For four 40-watt lamps per section. Total watts—192.

CURTIS *Lighting*, INC.

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS



Helping Cold Cathode offset Manpower Shortage

Industry has found another great reason for its swing to Cold Cathode lighting. *Cold Cathode* is helping offset the manpower shortage. Yes, because Cold Cathode is so intense, so shadowless—and at the same time non-glaring, non-tiring—it gets precision work done faster and more efficiently. It helps workers produce *more* vital war goods with *less* fatigue!

Industry likes Cold Cathode. But keeping industry sold depends upon performance—and that's where illumination engineers look to SOLA COLD CATHODE LIGHTING TRANSFORMERS.

Sola Transformers keep Cold Cathode "on the

beam." They're rugged, unaffected by shock or vibration, built for sturdy service 'round the clock. They assure the kind of operation—free from under-voltage flicker or overload failure—which keeps Cold Cathode doing its full share for victory.

When making installations, keep these two important facts in mind: 1. *The success of Cold Cathode leans heavily on the transformer.* 2. *Every significant improvement in luminous tube transformer construction during the past twelve years has originated in Sola laboratories.* Find out how Sola transformers can serve you. Send for bulletin JLT-96

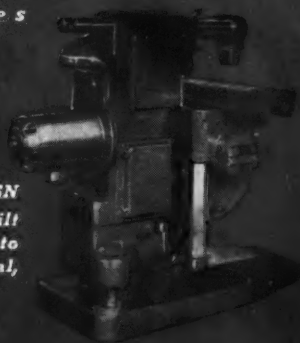
SOLA

Cold Cathode Lighting Transformers

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs • Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. **SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago, Ill.**

SIMPLE COMPACT DESIGN

The electric brake is built into the motor end cover to form a compact, economical, easy to use unit.



STOP FOR POSITION

Stop at the desired point for quickly and conveniently loading and unloading



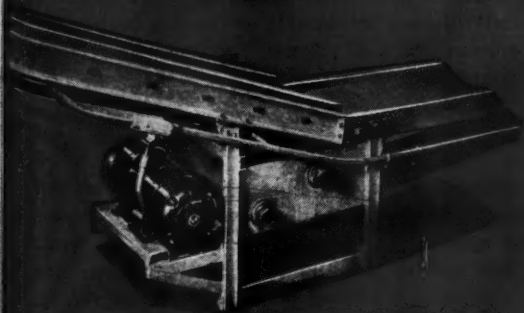
UNIBRAKE MOTORS

1/10 TO 100 HORSEPOWER

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

SPEED UP PRODUCTION

Eliminate unnecessary loss of time waiting for equipment to coast to a stop.

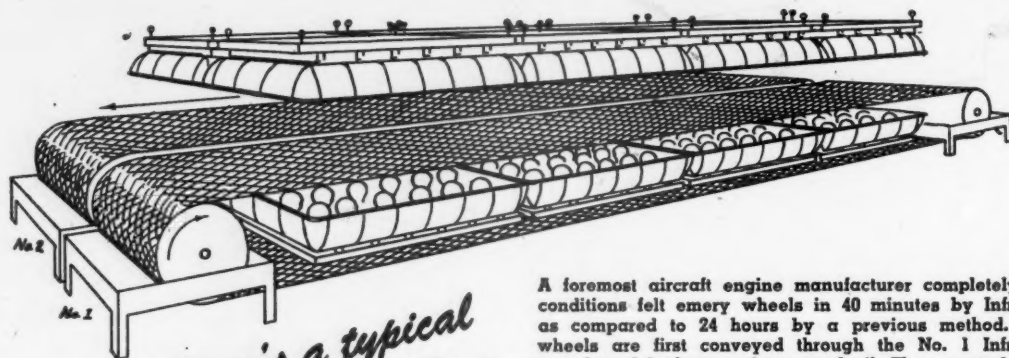


STOP AND HOLD ANY LOAD

Unibrake motors are very advantageous on hoists, elevators, inclined conveyors, etc....



IF YOU HAVE A BAKING-DRYING DEHYDRATING-PREHEATING *Problem* INFRARED WILL PROBABLY SOLVE IT



*Here's a typical
result of switching
to Infrared—*

A foremost aircraft engine manufacturer completely reconditions felt emery wheels in 40 minutes by Infrared as compared to 24 hours by a previous method. The wheels are first conveyed through the No. 1 Infrared tunnel to dehydrate moisture and oil. Then, coated with sizing, the wheels are dried in No. 2 tunnel. An emery coat is then applied and the wheels passed again through No. 1 tunnel. After another emery coat and return through No. 2 tunnel, the reconditioning process is complete. It is estimated this process will save thousands of dollars each year.

free BOOKLET—

explains the Near Infrared Process and its proven advantages in hundreds of industrial uses.



REQUEST A COPY, today!



WAR OR POST-WAR—THE WAY TO GET MORE AND BETTER PRODUCTION AT LOWER COST

In hundreds of war production plants today, the amazing production accomplishments in baking, drying, dehydrating and preheating operations are the result of Infrared equipment engineered by Fostoria.

Easy, quick and inexpensive to install and operate, Infrared turns hours into minutes, conserves manpower, saves space, eliminates troublesome production problems. Case histories in a wide variety of uses thoroughly prove the higher efficiency and greater utility of Infrared radiation over other forms of heat transfer.

To Test Advantages for Your Plant

Fostoria Industrial Service Centers, located in principal cities, have complete laboratory facilities to test and predetermine the specific advantages of Infrared in your production. This service including recommendations for equipment and practice is offered without obligation. Write, now, for full information.

THE FOSTORIA PRESSED STEEL CORPORATION
FOSTORIA, OHIO

IN CANADA—Write Amalgamated Electric Corp., Ltd., Toronto

Electrical Contracting, December 1943



MISSING ...yet still in action

For years, Manson Tape has occupied the highest position of all friction tapes. Whenever the utmost safety and permanence in splice protection was required, Manson Tape became the first choice of experienced engineers and electricians. Purchasing agents, too, willingly paid more to get lasting protection.

Contributing to this fine reputation of Manson Tape was the pledge of The Okonite Company to use only the best materials in its manufacture. One of these materials was a special type of natural rubber, which thoroughly impregnated and coated the strong, closely-woven cotton fabric. The exclusive use of this special type of new rubber was one reason why Manson Tape was unequalled in true adhesiveness and in aging and weathering qualities.

Today, with *all* new rubber forbidden for this use, the manufacture of Manson Tape has been tem-

porarily discontinued because, if made with the materials currently available, Manson Tape would not have the superior characteristics nor be of the same high quality that you have always known.

As an assurance to the thousands of electrical men who have so consistently used it, we remind them that older joints and terminals made with Manson Tape will stay protected for years to come. To those who are fortunate enough to have available a supply of Manson Tape, we suggest it be reserved for the most important jobs.



UNTIL MANSON TAPE IS AGAIN AVAILABLE

We recommend as an alternative, Dundee "A" Friction Tape which fully complies with all current Federal and A.S.T.M. emergency specifications.

THE OKONITE COMPANY

PASSAIC



NEW JERSEY

MANUFACTURERS OF INSULATED WIRES, CABLES AND TAPES SINCE 1878

Electrical Contracting, December 1943

15

The Pacific Echoes to the Roar of Guns



Associated Press Wirephoto (U. S. Navy)

Deck of one of our cruisers in full battle dress as men pour shells into enemy shore installation

NEWS BEFORE THE NEWS!

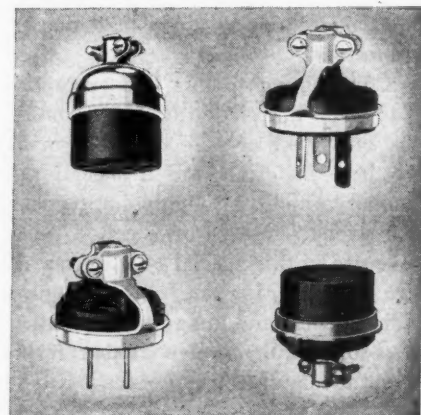
BEHIND THE SCENES, there is news, too—news that comes—in fact, *must* come—before news of victories. It is news of factories made more efficient—news of war plants, re-tooled, re-built virtually over night!

For, part and parcel of every story of ground gained by battle, is ground gained by *fighting* production—production that is every day heaping higher the tools of war.

Contributing full facilities to this vital war effort, the Bryant Electric Company is providing electrical devices for some of America's greatest installations.

Illustrated are four connecting devices for wartime industrial service. Superior in design and construction, they maintain good contact, help assure uninterrupted production schedules.

- No. 5103—Armored cord connector
(top, left) with "T" slots.
- No. 9112—3-wire armored cap with
(top, right) cord grip.
- No. JK—Composition cap with
(bottom, left) cord grip.
- No. 9114—3-wire armored cord grip.
(bottom, right)



Now more than ever... every outlet deserves a reliable Bryant device. Sold through electrical wholesalers.

THE BRYANT ELECTRIC COMPANY • BRIDGEPORT, CONNECTICUT

NEW YORK

SAN FRANCISCO

CHICAGO

LOS ANGELES

Free Enterprise

THE OPPORTUNITY AND OBLIGATION TO COMPETE

WE can be prosperous beyond our dreams—all of us—workers, farmers, and business men—but one of the prerequisites is the self-discipline of accepting competition for ourselves as well as others.

* * *

Free enterprise does not imply the freedom to use any or all means to make a profit. It does not mean the right to monopolize. *It means the opportunity and obligation to compete.*

Competition requires *independence of action, free access to the market, and no large degree of control over the price* by any buyer or seller. In general, the larger the number of sellers and the more easily buyers can shift from one seller to another, the higher will be the degree of competition (and vice versa for buyers).

But let us not get too academic or go off the deep end. We cannot have perfect competition. We cannot subdivide businesses and labor unions into tiny units to make a multitude of buyers and sellers in each market; we cannot reduce our rich variety of products to a few rigidly standardized items; we cannot educate people to judge quality precisely; we cannot eliminate the costs of bridging space between buyers and sellers. On the other hand, have we gone as far as is practical and desirable in these directions?

We cannot even have a system of highly "sensitive" prices, that is, prices which fluctuate immediately in response to every minor change in demand and supply. This would occur in the dream world of competition-to-the-nth-degree. It cannot occur in the real world, or even in the ideal world of competition best suited to physical facts and human qualities. The economies of large-scale enterprise, the need for adapting products to human wants, the costs of transportation and the costs of issuing and acquiring market information put severe limits on price sensitivity.

Economists tell us that if prices were extremely sensitive, business booms and depressions would be much less severe—provided our stock of money remained fairly constant. But with the somewhat limited degree of sensitivity which is practicable in the economy, price and wage changes cannot prevent severe declines in

business activity. *We cannot count on competition alone to cure depressions.* We must look mainly to other kinds of measures to prevent mass unemployment of men and machines.

If we cannot have prices which fluctuate with every small change in demand and supply conditions, we can work toward—and achieve, if we really want it—a system in which prices and wages are at least roughly responsive to long-run changes in demand and supply, a system in which most markets are not dominated by individual businesses, groups of businesses, labor unions, or farm organizations, and in which prices and wages are maintained at levels consistent with free access to markets and to jobs.

In any kind of an economic system there must be some means of determining prices, wages, and profits, and of bringing labor and capital into employment in the industry and place where they are most needed. There are two ways to do this: by administrative fiat or by the impersonal processes of the market. The first of these is typical of the totalitarian state; it frequently involves destruction of individual freedom or fumbling mismanagement. During the war all of us have had some experience with patronizing and paternalistic treatment by the state; we have found out what it means to be pushed around by bureaucrats; and we have discovered that the political determination of prices, wages, and profits leads to chaos when self-interest supersedes the fine fever of patriotism—as it eventually does. I do not mean to imply that we can do without controls over prices, production, and distribution in time of war; but I do suggest that we can learn something from their operation. Even with a united national purpose these controls work badly when human abilities are inadequate for the superhuman task, when personal or departmental jealousies crop up among officials, and when pressure groups try to prey on the rest of the public. Every day more Americans are beginning to understand why our forefathers feared the caprice and tyranny of power.

The impersonal processes of the market in determining prices and wages and in allocating productive resources will, in normal times, save us from the fumbling of bureaucrats and from the Babel of confusion, un-

certainty, and annoyance produced by their regulations. But these market processes will not save us from paying toll to those who monopolize and restrict entry to markets or jobs.

If we want an economy in which we are free to try out new ideas, develop new products, and introduce more efficient methods of production, if we want an economy in which there are great opportunities for men of imagination, inventiveness and energy, if we want an economy wide open to progress, then we must have a free field and fair competition for all comers—without collusion as to prices, markets, or production. This is the only basis on which we have a right to demand freedom from governmental regulation for ourselves and on which we can combat monopolistic tendencies in other quarters.

Let us stand squarely for the principles of the anti-trust laws and against all collusion and combination in restraint of trade. Let us insist that the government review with a critical eye every combination and consolidation which might restrict competition. Let us face frankly the problems of economic power arising out of price leadership and encourage every honest effort to find means to deal with them. Let us not shrink from questions as to whether some great aggregations of plants are too large for efficiency, free entry into the industry, and a free price. While we resist the efforts of the Department of Justice to extend the anti-trust laws by far-fetched and distorted interpretation, and while we fight every attempt to use them as a tool of persecution, let us cooperate in sincere efforts to modernize these laws and extend them by specific legislation to monopolistic practices they cannot now reach. I do not have a simple formula for this, but I believe we must try to find one.

We can then, better face the problem of the growing monopoly in labor which is threatening to make the free enterprise system unworkable. Today labor is going through a stage of empire building reminiscent in some ways of a similar stage in business three-quarters of a century ago. Witness the same buccaneering spirit, the same concentration on selfish interests, and the same disregard for the public welfare. Business leaders learned the hard way that the public will eventually rise up against those who prey upon them. Will our labor leaders be wiser? The right to collective bargaining to protect the weak position of the individual employee is one thing—but the grant of unlimited monopoly privilege to combine into a private government which can dictate its own terms to businesses, industries, communities, and even to the government itself, and which can start a wage-price spiral such as to hinder the war

effort and make full prosperity impossible in time of peace is something quite different. We need to find a middle way which will prevent employers from exploiting employees but which does not sow the dragon's teeth. The exercise of arbitrary power by labor threatens not only business, but also all workers outside the unions and all those dependent on pensions and savings for their existence, and ultimately, of course, the well being of union workers themselves.

The idea that the labor problem can be solved if great, powerful organizations of employers will sit down with great, powerful organizations of labor is a delusion. If our experience in the N.R.A. and in the war teaches us anything, it is that the best that can be expected in the long run from such a situation is an armed truce with intermittent civil war. And every truce would be a monopolistic arrangement to take advantage of those not members of the great organized groups. Business and labor unions, whenever confronted with postwar readjustments that are unfavorable to them will be sorely tempted to protect their own special interests at the expense of the public. There will be efforts on the part of businesses, abetted by labor unions, to limit productive capacity, to raise tariffs, to obtain subsidies, and to maintain prices at artificially high levels. The unions will oppose labor saving changes and will seek higher wages even in areas and industries of surplus labor. Already demands are emerging for direct joint action by business, labor, and agriculture to solve the transition problems of special concern to them. While these groups should have every opportunity to register their own self-interest, we cannot entrust our fate to decisions made by pressure groups. If experience is any guide, such coalitions will be almost certain to restrict opportunities for progress and expansion, to exploit the public, and ultimately to injure even the businesses, workers, and farmers included in them. We cannot afford a postwar N.R.A. Resort to temporary government regulation in the transition from war to peace may, however, be necessary in cases of great hardship.

We can be prosperous beyond our dreams—all of us—workers, farmers, and business men—but one of the prerequisites is the self-discipline of accepting competition for ourselves as well as others.



President, McGraw-Hill Publishing Company, Inc.



*"There's Tested Strength
in Every Length"*

PROTECTION -for the years ahead

CENTRAL Rigid Steel Conduit, installed now, assures you of power circuit protection for many, many years—at low cost. It has built a good reputation by serving well in installations of all kinds.

SPANG-CHALFANT

Division of The National Supply Company
Executive Offices: Grant Building, Pittsburgh, Pa.
District Offices and Sales Representatives in Principal Cities

Torque Talks

ON MOTORS FOR WAR AND
POST-WAR NEEDS

5 GENERAL PURPOSE TYPES

THAT MEET 80% OF SMALL MOTOR
DRIVE REQUIREMENTS

Standard small motors can be designed to meet almost any combination of electrical and mechanical requirements for war and peacetime applications. And when products can be designed around a standard motor type, many advantages are gained... lower cost, quicker delivery, simplified maintenance.

For example, the five standard types shown here, when properly applied, will meet the majority of small motor drive requirements. Observe these five fundamentals in selecting them:

1. **What power supply must motor fit?** Voltage, frequency, phase (if a-c); and voltage (if d-c), are first considerations.
2. **What horsepower is required?** The motor must not only start and run the unit it is driving, but also handle any momentary overload. In case of doubt, application tests should be made. Duty cycle and frequency of starting may also affect size.
3. **What torque is required?** Motor torque characteristics must match those of load. Therefore, consider load requirements in terms of starting and breakdown torque. Curves, on the opposite page, show comparison between motor types.
4. **What are starting current limitations?** Many power companies restrict use of motors with high starting current. All motors shown here have locked rotor currents within NEMA standards for 115-volt motors, except the type FHT.
5. **Should burnout protection be applied?** (Single-Phase motors only.) When a motor is subject to overload or abnormal heat, built-in Thermoguard protection should be used.

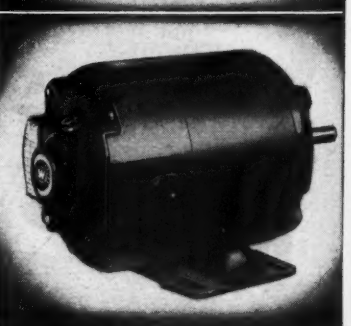
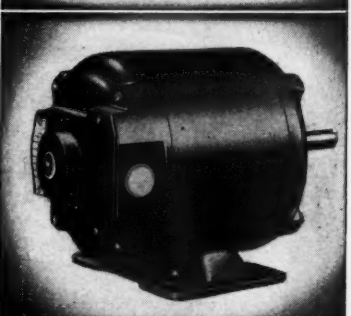
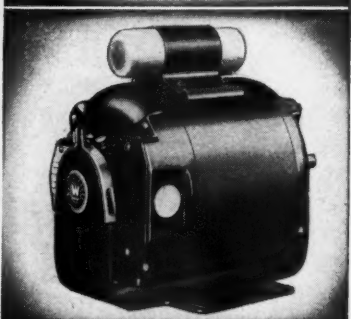
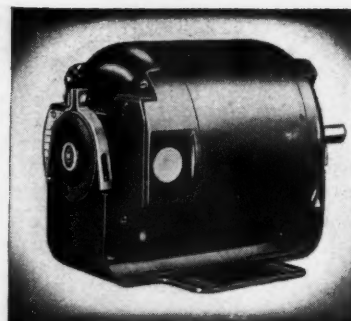
Small motors have gone to war... some on wartime applications of peacetime products... many others on specialized war applications. For further information on Westinghouse small motors, watch for additional "Torque Talks." Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N. J-03194



Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

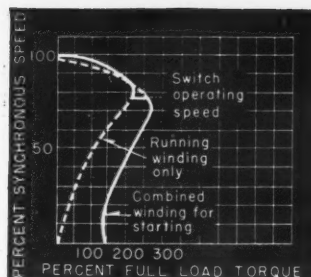
SMALL MOTORS



SPLIT-PHASE MOTORS • TYPE FH

For Single-Phase applications where medium starting and breakdown torques are sufficient. Low starting current makes motors suitable for frequent starting applications. Available with rigid or resilient mounting. Reversed by changing terminal block connections.

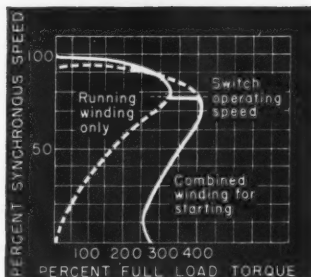
HORSEPOWER—1/20 to 1/3
PHASE—Single
CYCLES—60, 50, 25
VOLTS—115 or 230
SPEEDS—Approximate Full Load Rpm.
 60 Cycles—3450, 1725, 1140, 860
 50 Cycles—2850, 1425, 960
 25 Cycles—1425



SPLIT-PHASE MOTORS • HIGH TORQUE • TYPE FHT

For Single-Phase applications where high starting and breakdown torques are needed, where starting is infrequent and where starting current in excess of NEMA values is not objectional. Available with rigid or resilient mounting. Reversed by changing terminal block connections.

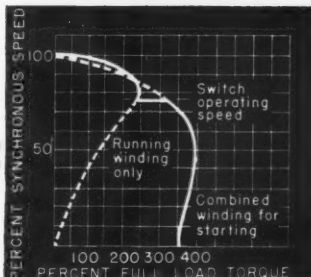
HORSEPOWER—1/6, 1/4, 1/3
PHASE—Single
CYCLES—60, 50, 25
VOLTS—110 or 220
SPEEDS—Approximate Full Load Rpm.
 60 Cycles—1725
 50 Cycles—1425
 25 Cycles—1425



CAPACITOR-START MOTORS • TYPE FJ

All-purpose Single-Phase motors for extra high starting torque, low starting current, quietness and economy. High efficiency and power factor. Dual voltage in all but 1/6 and 1/4 hp. 4-pole sizes. Available with rigid or resilient mounting. Reversed by changing terminal block connections.

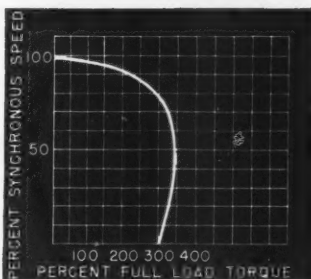
HORSEPOWER—1/6 to 3/4
PHASE—Single
CYCLES—60, 50, 25
VOLTS—115 or 230 for 1/4 hp. 4-pole and smaller; larger sizes are 115/230 Dual voltage.
SPEEDS—Approximate Full Load Rpm.
 60 Cycles—3450, 1725, 1140, 860
 50 Cycles—2850, 1425, 960
 25 Cycles—1425



POLYPHASE MOTORS • TYPE FS

For all applications where polyphase circuits are available. Squirrel-cage induction type motor with high starting torque and extra high breakdown torque. Dual frequency, 60/50 cycles, 2 or 3-phase. Motors can be reversed while in motion by use of proper starting switch.

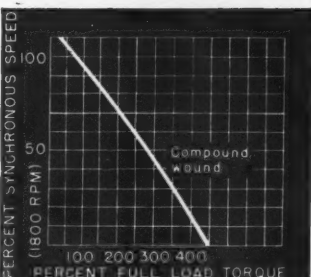
HORSEPOWER—1/6 to 3/4
PHASE—2 or 3
CYCLES—60/50 (Dual Frequency) or 25
VOLTS—110, 220, 440, 550
SPEEDS—Approximate Full Load Rpm.
 60 Cycles—3450, 1725, 1140, 860
 50 Cycles—2850, 1425, 960
 25 Cycles—1425



DIRECT-CURRENT MOTORS • TYPE FK

For all applications on direct-current circuits. When compound winding is used, starting torque is extra high. Speed may be increased up to 15% by means of a field rheostat. Starting rheostat is recommended for ratings 1/2 hp and larger.

Reversed by changing connections.
HORSEPOWER—1/20 to 3/4
VOLTS—32, 115, 230
SPEEDS—Approximate Full Load Rpm.
 3450, 1725, 1140



WESTINGHOUSE



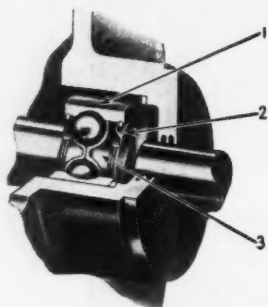
SMALL MOTORS

MAKING MOTORS *Last Longer...* Easy as 1, 2, 3 if they're

R & M Uni-Shell INTEGRAL HORSEPOWER MOTORS

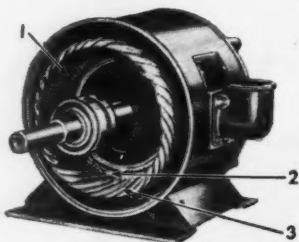
One of the two main reasons for motor deterioration is *bearing wear*. The second is two-fold: *poor insulation* and *excessive heat*. Both these primary causes of motor failure are conditions which R & M Uni-Shell Motors have been designed to eliminate. With them, you get wartime "day-in-night-out" trouble-free operating reliability... as easy as 1, 2, 3. This is why:

1·BETTER BEARINGS...



1. Double-row width bearings for greater lubricant supply. 2. Complete seal, both sides... held in by snap rings that are quickly removable for inspection, cleaning, and regreasing. For trouble-free operation... keeps grease in... dirt out. 3. Large grease reservoir for more lubricant... less maintenance.

2·BETTER INSULATION...



1. Two layers of highest-grade impregnated rag paper. Wire coated with double-weight synthetic resin for strength and flexibility. 2. Added sheet of impregnated paper between coils in slot. 3. Entire winding given several baked coats of synthetic resin-base varnish... covered with moisture-resistant synthetic resin and tung-oil sealer... guards against time-thieving breakdowns.

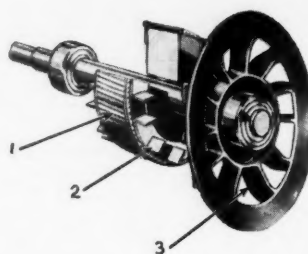


ROBBINS & MYERS, INC.

MOTOR DIVISION, SPRINGFIELD, OHIO

HOISTS & CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

3·BETTER BALANCE and FAN CONSTRUCTION...



1. Ground rotor surface assures uniform air gap for quiet, smooth operation. 2. Pressed-steel fans for larger ratings... on totally-enclosed motors... to provide greater cooling—longer life. 3. Cooling fan produces maximum of measured cooling air flow for low-temperature, longer-life operation.

Add to these design features the flexibility of mounting provided by Uni-Shell interchangeability. For shell length, diameter, base mounting holes, shaft dimensions, height of shaft above base, head fit, and bolt circle mounting for heads are exactly the same for any one frame size.

These benefits, taken together, are the reason why more and more Uni-Shell Motors are doing an increasingly larger job of supplying the power for industry's needs. Learn how you, too, can profit by their use. Get all the facts, at first hand, by asking for your free copy of the new, helpful, 20-page R & M Uni-Shell Motor booklet, today.

SHIPMENT NOW!

Ample stock on all types of integral motors on hand as this goes to press. Wire or phone your inquiry.

Mail This Coupon, Now!

ROBBINS & MYERS, INC., Springfield, Ohio

Please send my free copy of the new, informative Uni-Shell Motors booklet.

Name.....Dept.....

Company.....

Address.....

City.....State.....

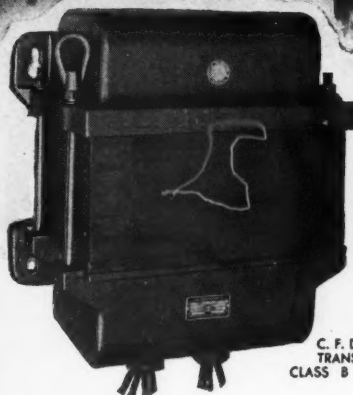
I would ☐ would not ☐ like to talk to a representative.

TRANSFORMERS

on the job... at the job!



W. F. DRY TYPE
TRANSFORMER
CLASS B
INSULATION



C. F. DRY TYPE
TRANSFORMER
CLASS B INSULATION



C. F. T. 3-PHASE
DRY TYPE
TRANSFORMER
CLASS B INSULATION

AmerTran Dry Type Transformers are made in a variety of ratings for a wide range of applications. Small and light, they permit installation at nearest available location to load center. Thus, they save secondary copper, reduce line losses, obtain improved voltage regulation and gain added load flexibility for future demands.

Their incombustible insulation (glass, porcelain and asbestos) eliminates the need for vaults—saving space as well as installation costs. Their higher permissible temperature rise (80 degrees C.) allows heavier loads on the windings. With no liquid to drip, they can be placed overhead, if desired. And maintenance is practically nil since there is no sampling or changing of liquids, no watching or servicing valves, diaphragms and gaskets.

AMERICAN TRANSFORMER COMPANY
178 EMMET STREET • NEWARK 5, NEW JERSEY

AMERTRAN

**Pioneer Manufacturers of
Transformers, Reactors
and Rectifiers for
Electronics and
Power Transmission**

CHICAGO'S SUBWAY



YESTERDAY

... GARCY gave all its skill so that America's millions might enjoy better lighting. But that was before Pearl Harbor.

TODAY

... our facilities are almost totally occupied with vital war assignments. On every front the products of our hands and hearts and brains are helping to smash the Axis and speed the day of Victory.

TOMORROW

YOU MAY AGAIN LOOK TO
GARCY
FOR LEADERSHIP
IN LIGHTING



BEST STORE LIGHTING
BEST BANK LIGHTING
BEST OFFICE LIGHTING
BEST HOSPITAL LIGHTING
BEST FACTORY LIGHTING

*and now
we add —*
**BEST
SUBWAY
LIGHTING**

Acclaimed by lighting experts as the best in the country, the comfortable, glareless and shadowless fluorescent illumination of Chicago's brand-new State Street Subway adds one more to the impressive list of "bests" manufactured by GARCY.

Today we have a different job to do. But when it is done and the lights go on again, GARCY will make them brighter and better with the new skills, engineering advances and improved facilities developed while working for Victory.

GARCY
LIGHTING

GARDEN CITY PLATING AND MFG. CO.
COR. OGDEN BLVD. & S. TALMAN AVE., CHICAGO, ILL.

GARCY
HARDWARE



5 INCHES CAN **EQUAL 5 MILES**

He was loping along, crouched over. The reel of wire on his back paid out steadily. Then, he heard the queer, uneven rhythm of a Nazi plane. He dove into a shell hole. The bullets splattered around the edge...the plane roared off into the blackness. He was safe...but one of the bullets had cut the wire...the only means of communication with headquarters. He was five miles from nowhere...deep in the heart of enemy territory...alone.

He shook his head to clear it a little, fumbled in his pocket for his repair kit. There were the pliers...there was the tape. He pulled the end loose with his teeth, snipped off a length, spliced the ends of the broken wire. Then he plugged his 'phone in. Cranked. His receiver crackled for a second. Then he got his answer from headquarters.

He had established contact again. Five inches of tape helped bridge five miles of enemy territory.

UNITED STATES RUBBER COMPANY

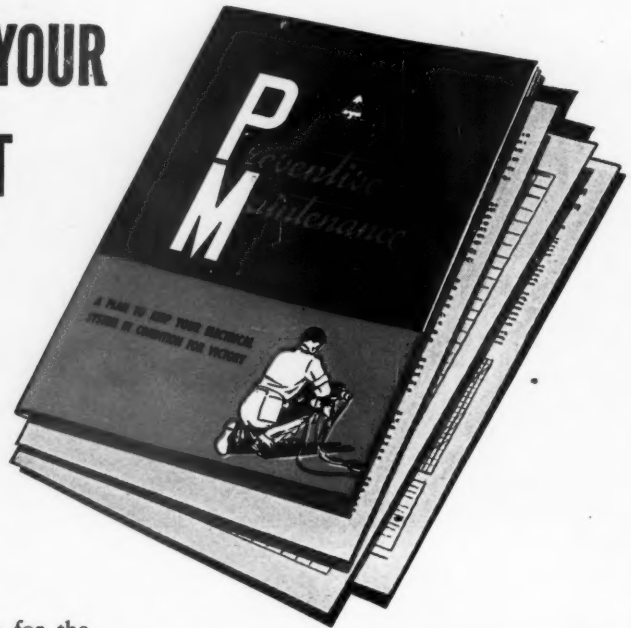
1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20



SECURITY ON ALL FRONTS

HERE'S HELP ON YOUR MOST IMPORTANT WAR JOB

-the PM plan simplifies
industrial plant
maintenance



With construction cut to a minimum for the duration, maintenance of industrial electrical equipment is the contractor's most important war job. By such a program, he has a direct hand in helping industry maintain continuous wartime production—despite shortages in essential war-time equipment.

Based on an annual maintenance agreement, contractors can offer: regular and systematic inspection and repair; service by specialists on

electrical problems; broad experience gained over a period of years, in many plants; up-to-date methods and materials; proper tools and equipment, to do a thorough job.

To aid contractors in this vital activity is Anaconda's aim. With this in view, the Preventive Maintenance Plan was designed. Although introduced only recently, over 12,000 free Plan Manuals have already been sent out on request.

WHAT THE PLAN IS

The PM plan is a simple but comprehensive guide which can help you maintain electric wire and cables in busy war plants and thus help safeguard continuous peak production.

HOW IT WORKS

The plan provides a practical means of making a periodic, systematic analysis of circuits and equipment. Uncovers potential weaknesses...

suggests ways to correct them... prevents overloading of lines.

Data thus gathered aids local W.P.B. Branches in reaching decisions on requests for materials to prevent accidents.

NOTE: Your Anaconda Distributor will gladly cooperate in working out the program.

HOW THE CONTRACTOR BENEFITS

The PM plan assists in carrying out the all-important maintenance pro-

gram. Helps keep business going and trained personnel together during construction lull... enables contractors to put employees on an annual, rather than hourly, wage rate... helps keep old customers, gain new ones, despite lack of products to sell... puts electrical contractor in leadership role for furthering the war effort.

If you aren't already utilizing the Anaconda Preventive Maintenance Plan, mail the coupon for full details.

43297B

"Tomorrow may be too late... do it today!"

**ANACONDA'S PREVENTIVE
MAINTENANCE PLAN**

Anaconda Wire & Cable Company
25 Broadway, New York City 4

Please send copy of the Anaconda Preventive Maintenance Plan for safeguarding wartime production.

Individual

Company

Address.....City.....

127

Electrical Contracting

YEAR END INVENTORY

Some day we ought to have the means to make an accurate industry-wide inventory at the year end. We ought to be able to readily count, measure, value and total our markets, prospects, facilities, manpower and stocks, for example. As it is, our data must be drawn from many sources, approximated as closely as possible and the values charted within rough limits.

The experience of 1943, which ought to go into our industry inventory, will have to wait until the close of the year before accurate accounting is possible. Yet significant data is at hand to help us set our sights for the new year ahead.

We know enough of the picture, indeed, to recognize 1943 as a substantially big year in volume of electrical construction, short of 1942, but still well above average.

We know, too, that 1943 saw many electrical contractors engaging in ship wiring and setting new records for efficiency in that field. The total volume of such work handled by contractors is difficult to estimate. However, it has compensated to a large extent for the decline in construction.

Electrical maintenance work in 1943 reached new levels beyond any previous year. The logic of this in-

crease is readily apparent. Stiff war schedules are depreciating wiring and equipment at a greatly accelerated rate. And much apparatus that would normally be replaced is being propped up for the duration until critical shortages are relieved and new apparatus is available.

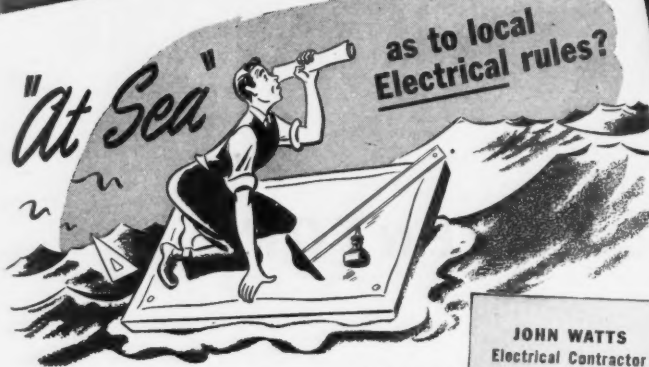
And 1943 marked the beginning of a comprehensive postwar plan developed jointly by NECA and IBEW, one of the first of such scope in American industry. It also marked a rapid development in industrial electronics with a parallel search for knowledge about it among our people.

These are all parts of our industry inventory at this year's end. Our stock of experience and foresight is much better than last year. Our courage and confidence in the future progress of our industry is stacked up higher than ever. Altogether it is a good inventory and a valuable stockpile for the new business prospects and opportunities that 1944 will bring.

Wm. J. Stuart

DECEMBER, 1943

Electrical Contractors...



Put through a call to...

INNOVATIONS in electrical construction are on the increase. In industrial plants, commercial buildings, private homes, new ways of doing things electrically call for more power, more circuits, more widespread use of newly developed equipment.

IF YOURS is the modern viewpoint — if you are keeping up-to-the-minute as to electrical products and practices — there's probably still one problem that has you completely "at sea": **HOW FAR CAN YOU GO IN ELECTRICAL PIONEERING WITHOUT COMING INTO CONFLICT WITH LOCAL ORDINANCES, RULES OR UNDERSTANDINGS?** Will that layout that worked in Detroit be permitted in Smithville, or vice versa? Will it meet code requirements?

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This advertisement is one of a series which **GRAYBAR** is running in the *Architectural Forum* urging that they make more effective use of your "know-how" and facilities. Telling *your* story to builders is but one phase of **GRAYBAR** service to electrical contractors — a service which includes everything you need in the way of supplies. **Graybar Electric Company, Inc.**

Electrical Contracting, December 1943

ISLAND PLATFORMS have an average of 7.1 foot-candles of shadowless fluorescent illumination. Fixtures mounted to underside of supporting girders are the d. c. incandescent emergency units.



Fluorescent lighting made its underground debut with the completion of the first link of Chicago's new subway system, opening a new era in subway and underground illumination.

LIGHTING

Chicago's NEW SUBWAY

WHEN the first five-mile link of Chicago's new subway system was opened to the public on October 16, it marked a milestone in the expansion and modernization of the city's transportation facilities. It also marked the first application of the fluorescent lamp as a light source for subway illumination.

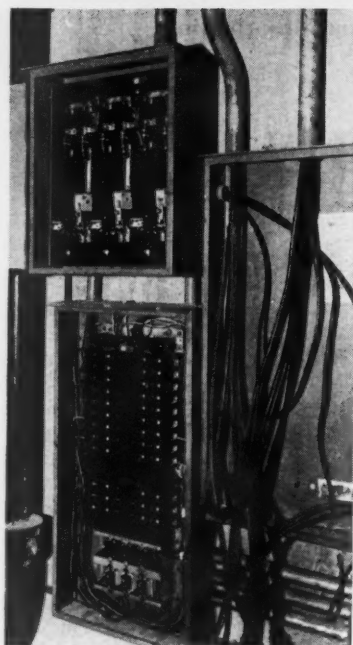
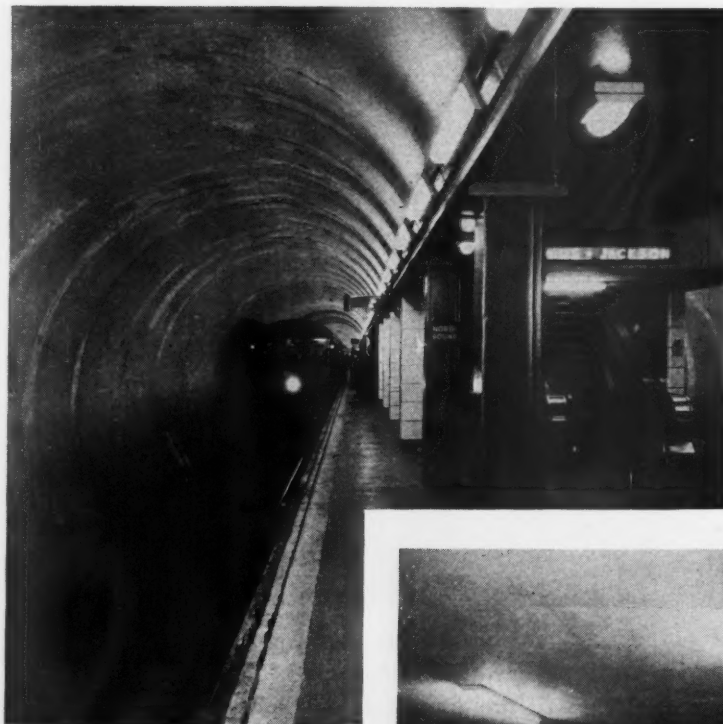
Upon entering the station, one of the first impressions is that of walking into a pleasant, cool, well lighted area. Much of that may be attributed to the newness of the project, the light colored tile walls and the blended color scheme which adds to the light reflectivity. Basically, however, it is the cool, well distributed, glare-free, shadowless, fluorescent lighting that minimizes the feeling of being in an underground tunnel.

Many problems had to be solved before the engineers' demand for a sturdy

dependable unit was satisfied. The application of fluorescent units to subway operation was a pioneering venture on their part and they carefully studied all aspects. The decision to utilize this light source was made as far back as 1939 to enable the engineers to make their system designs accordingly and to permit circuits to be embodied in the tube construction. Their specifications demanded that the unit be able to operate under low temperatures; be dependable under all probable weather conditions; have a high efficiency with proper diffusion and distribution adapted to low ceiling conditions; have a pleasing appearance and gasketed joints for dust-tightness; be durable, sturdy and accessible for maintenance; have close tolerances to permit interchange of parts; and meet wartime limitations.

Since no commercial fluorescent fixture had been developed to meet these conditions, a complete new design was prepared by the subway engineers, with the cooperation of the lamp and fixture manufacturers. The accepted fixture is of the single-lamp, 40-watt type with an overall depth of four inches, including the enclosing glassware. The body of the unit is mounted to a one-piece base plate with overlapping sides which support the reflector. These two parts form, in effect, a box girder housing the wiring, starter, and single-lamp, high power factor ballast which is mounted direct to the base plate to aid heat dissipation. The rectangular frame holding the glass enclosure is in the form of a truncated pyramid, one side of which is hinged to the base plate, the other being equipped with a concealed spring

TUBE SOFFIT LIGHTING highlights platform edge and takes advantage of train tube wall reflection. Fluorescent units are mounted on a continuous run of parallel steel duct line.



LIGHTING CONTROL panel has sectionalized circuit groups operated through single pole magnetic contactors (above) with control button in cashier's booth. Knife switches isolate contractors for maintenance. Cabinet at right is for automatic transfer switch for emergency service.



STATION MEZZANINE areas are illuminated to 5.4 foot-candle intensity with ceiling mounted, single-lamp, 40-watt fluorescent units. Cashier booths and direction signs are also fluorescent.

latch operated through a key slot. Mogul size, four-contact, thermal starters with a range of dependability as low as zero degrees F. are used to insure lamp operation under low temperature conditions. A total of 2,850 of the four-foot units are used for station general lighting and 86 two-foot units for cashier booths. White fluorescent (3500°K) lamps are used.

Mezzanine and Platform Lighting

Illumination intensity in the station mezzanines ranges from 4.6 to 7.4 foot-candles with an average of 5.41—better than the 5 foot-candles suggested in the Recommended Lighting Standards. The

units are mounted direct to the 8-ft. ceiling on 10 to 16-ft. spacings and fed by conventional concrete boxes in the ceiling slab. Similar mounting is employed in the stairways, escalator wells and corridors leading to the mezzanine areas. Structural glass, glazed tile and marble walls, light colored ceilings and blended floor surfaces increase the light reflectivity. Fluorescent units are used in all cashier booths and illuminated direction signs.

Lighting at the loading platforms presented a different problem. Here arched ceilings, with crowns ranging from 11-ft., 6-in. to 13-ft., 6-in. above the platform, were encountered in different stations. Four-foot, single-lamp fluorescent fixtures are ceiling mounted, on 15-ft. centers down the middle of the arch, utilizing the reflectivity of the painted concrete arch. Tests indicated light intensities varying from 6.4 to 9.2 foot-candles, the higher intensities being

along the platform edge. These values, averaging 7.14 foot-candles, are well above the 2 foot-candles as suggested for train platforms in the Recommended Lighting Standards.

To illuminate the platform edges to such a degree, a line of fluorescent fixtures were mounted the full length of the platform on the soffit of the train tube, taking full advantage of the light that is reflected from the train tube arch. Installing the four-foot fixture in this location presented somewhat of a problem. The solution lay in the use of a double, parallel run of ordinary steel underfloor duct mounted on the surface of the arch. The distance between ducts is such that the base of the fixtures just

covers the outer edge of the ducts. Each double duct section was prefabricated in 7½-ft. lengths with the spacers between ducts tapped to take the fixture mounting bolts. With one unit per duct section, the spacing between fixture centers is 7½ feet. The top duct houses the general lighting circuits while the lower duct is used for sign light circuits and future circuits if necessary. Fixtures are connected to the duct circuits by right angle flexible conduit connectors and extensions to the fixture.

Lighting Distribution and Control

Alternating current, used for lighting and miscellaneous power such as drainage pumps, ejector compressors, ventilating fans and escalators, is secured from the Commonwealth Edison Company's a.c. network system. The points where the 120/208-volt, three-phase, four-wire service connections were made

of service. Bypass and disconnect switches can isolate the transfer switch for maintenance without interrupting service. Except where equipment is in duplicate, two feeders are provided from the switchboard to the power and lighting distribution centers. In general, each power and lighting distribution center is served by one feeder from the switchboard, and one from a sub-distribution cabinet which provides emergency feeds to other power and lighting centers.

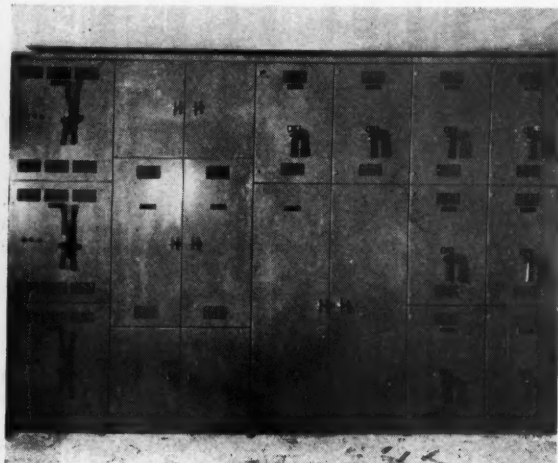
Lighting distribution centers are located in the mezzanine stations, on the station platforms and in service rooms along the train tubes. A transfer switch has been provided at each center to transfer the load from the normal to the emergency feeder. In readily accessible locations these are manually operated and in the remote locations they are automatic.

Remote control of the lighting circuits

lights to decrease the load during slack hours and to prevent excessively dark areas in the event of a circuit failure. The stroboscopic effect of the single-lamp fixtures is minimized by staggering alternate fixtures with respect to phase connection.

D.C. Emergency Lighting

Of prime importance in subway lighting is continuity of service due to the hazards involved if any portion of the subway should be left in total darkness. Supplementing the duplicate a.c. lighting sources, is a separate limited emergency d.c. lighting system fed from the 600 volt d.c. traction power system. Distribution centers are located adjacent to the a.c. centers. A 600 volt d.c. lighting main, running the length of one train tube, is the normal feed for this emergency system. Additional protection against failure is accomplished by



DEADFRONT SWITCHBOARD for power and light service and distribution contains feeder air circuit breakers and automatic transfer switch for dual service tie-in.



DUCT BENCH consisting of 12 "transite" ducts carries positive and negative reinforcing traction feeders (supplementing contact rail capacity), as well as all signal cables.

were determined by the load centers and the economical length of distribution. In general, service entrances are provided at each station and at intermediate points where concentrated loads such as drainage pumps and ventilating fans exist. A total of 21 service entrances serve this first link of the subway system, with duplicate services provided at each point.

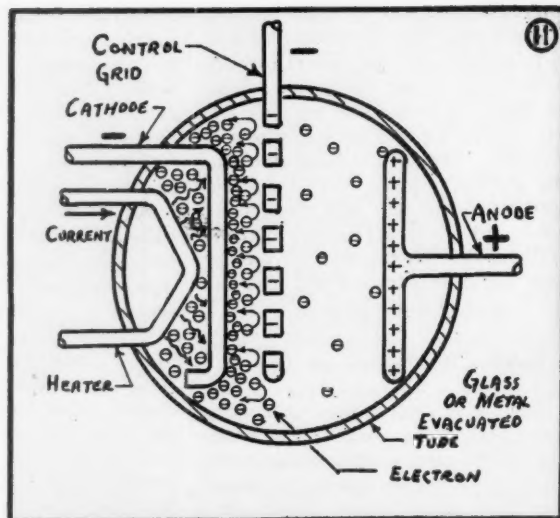
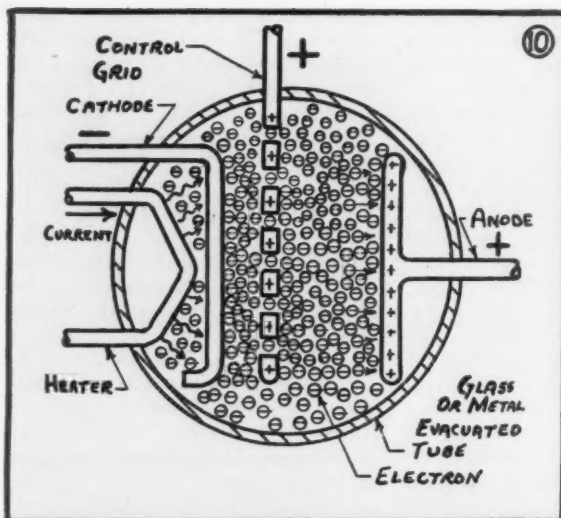
Totally enclosed service switchboards include air circuit breakers for all service and distribution feeders. In the event of a service failure a latched-in, circuit breaker type of automatic transfer switch transfers the load to an emergency source, automatically returning it to the normal source upon resumption

is divided into three groups designated as "24-hour", "rush-hour", and "non-rush hour." Each group terminates in a common section of the lighting cabinet; each section being fed through a contactor which is controlled at the cashier's booth. To facilitate maintenance, double-throw knife switches are used to isolate the contactors without interrupting the load. Group control switches are also provided in each lighting cabinet which take preference over the cashiers' control switches. These provide local control for maintenance and special lighting requirements. Individual circuits are protected by a thermal type circuit breaker. Circuit wiring, in general, is arranged for alternate control of

taps made to the third rail or power feeder sections at each distribution center with an automatic transfer switch to shift to the emergency lighting source in case of necessity.

The emergency lighting fixtures have the same general appearance as the fluorescent units and are mounted on the underside of the girders supporting the arches at the loading platforms, and on the mezzanine, stair and passage way ceilings. Each circuit consists of five, 56-watt railway type lamps connected in series. On the loading platforms these units are located on the bottom of the steel girders midway between columns having a spacing of ap-

(Continued on page 82)



Fundamentals of ELECTRONIC

IN 1907 De Forest inserted a metallic grid between the filament and the anode of a two element tube. It was found that the electrostatic field of a negative grid partially neutralized the electrostatic field of the positive anode. The net result is the same as an increase in the space charge and the anode current would decrease from the value it was when the grid was at zero potential. A positive potential on the grids assists the field of the anode. Hence, it corresponds to increasing the anode potential; but due to the proximity of the grid to

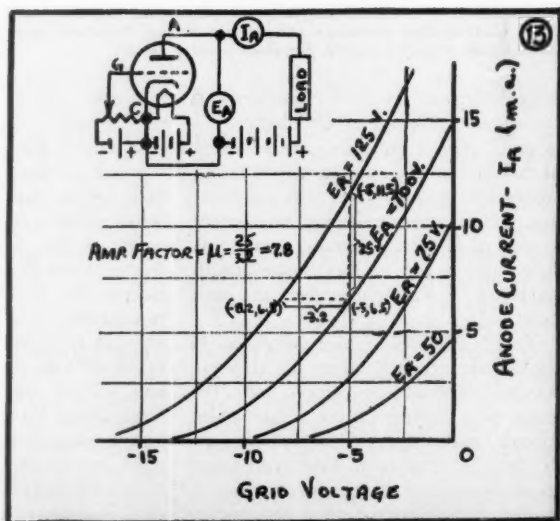
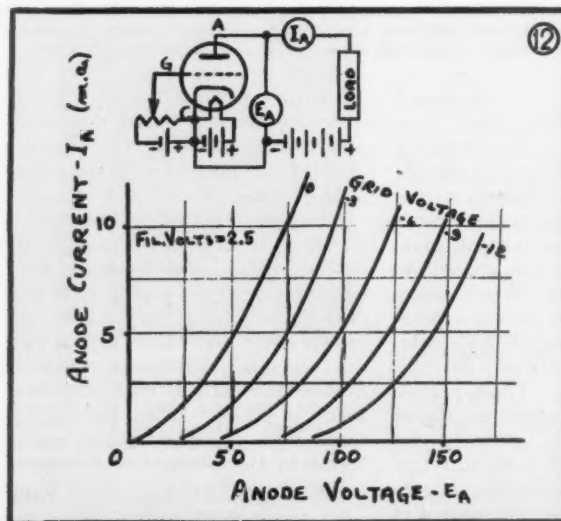
the cathode the grid potential change will produce greater effect on the electron flow than the same change in anode potential. Figures 10 and 11 illustrate the effect of a positive and negative grid potential upon the anode current.

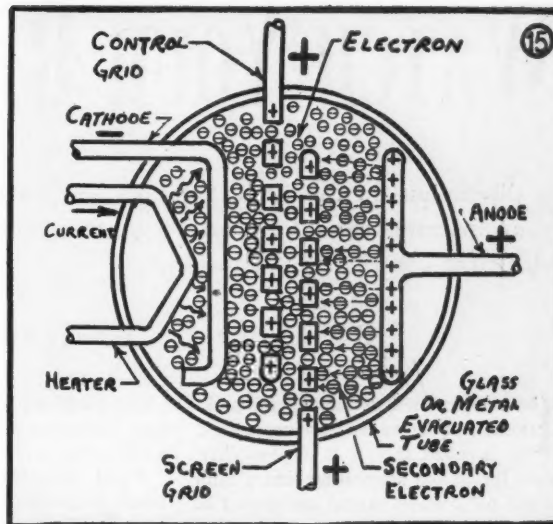
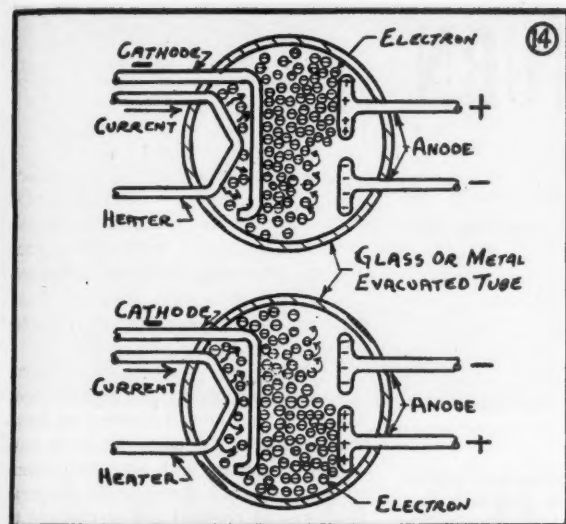
D. Grid Controlled Tube—Vacuum Triode

The three element tube which is known as a *triode* acts like a regulating valve, as the grid can very effectively control the anode current flow by a change in grid potential.

Fig. 12 shows the static anode current vs. anode voltage curves for a given value of grid potential. This set of curves shows very clearly that for a given anode voltage, a change of a more negative grid voltage reduces the anode current as its electrostatic field partially neutralizes the electrostatic field of the anode.

Fig. 13 shows the static anode current vs. grid potential curves for a given or constant anode voltage. From these curves it can be seen that the anode current may be changed the same amount



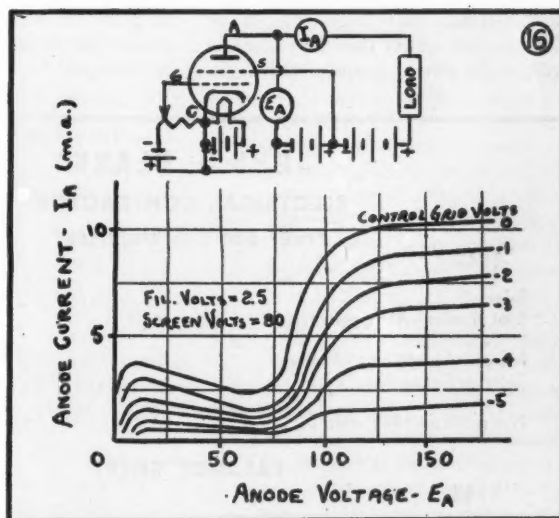


VACUUM TUBES—No. 2

Grid control permits regulation of electron flow. This article continues the discussion of tube characteristics through the grid controlled tubes including the cathode ray.

By Ralph B. Immel

Control Engineer
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.



by a relatively small change in grid voltage (anode voltage held constant) or by a large change in anode voltage (grid voltage held constant). This grid control characteristic may be utilized for an amplifier, as a very small change in grid voltage is equivalent to a very large change in anode voltage. A small amount of grid control energy can control a very large amount of energy in the anode circuit. The amplification factor of a tube μ is the ratio of change in anode voltage to a change in grid voltage in the opposite potential to hold the anode current at a constant value. When either the anode or grid voltages are changed, the other potential is maintained at a constant value. In Fig. 13, for the curve with a grid potential of -5 volts and an anode potential of 100 volts, if the anode poten-

tial is increased to 125 volts, the grid potential must be made 3.2 volts more negative (-5 to -8.2 volts) to hold the anode current constant. The ratio of 25 volts to 3.2 volts gives an amplification factor or 7.8. A typical triode tube may have an amplification factor of as high as 20 or 30.

This tube may also be thought of as a variable resistor. The grid potential can control the anode current just as a variable resistor can be manually controlled to vary the current in the circuit. If an alternating current radio signal is applied to the grid, an amplified alternating signal will be superimposed upon the d.c. anode voltage in the anode circuit. The amplified signal will not be distorted if the range of plus and minus grid voltage operates upon a linear or straight portion of the curves

shown on Fig. 13. The grid takes little or no energy from the circuit whose voltages are amplified. Triode tubes are sometimes known commercially as Plotrons. Fundamentally a tube does not amplify a current, but amplifies voltage applied on the grid which may be translated in terms of current.

E. Full Wave Vacuum Rectifier Tube

Fig. 14 shows a three element full-wave rectifier tube. In this tube the third element is an anode in place of a grid. This tube is not grid controlled and is the equivalent of two single diode tubes built into one unit. This tube is convenient and economical to use in low d.c. power units as only one heater is used for both anode circuits. At a given instant of time only the positive anode

[Continued on Page 73]

WATCH YOUR RETURN

A discussion on the importance of watching the return on your invested capital by an accountant specializing in the electrical contracting business.

By Arthur Roberts

THE government is looking for additional sources to tax for income and the invested capital is a possibility, some legislators advocating that a limit of six per cent on capital investment be decreed. This may put many electrical contractors in a financial hole so it is most essential that more thought be given to this matter than heretofore in order to be able to appraise such legis-

lation as it applies to business and to take intelligent action to counteract an undesirable tax.

From our field studies among electrical contractors, we estimate that, roughly, 85 per cent do not consider the return on capital investment, only the net profit on sales. If they earn a reasonable percentage on sales, they are satisfied, yet, the ultimate profitability

of a business is measured by the return on invested capital. The capital invested in your business is the original investment augmented by profits earned each year or diminished by losses deducted. The net profit on sales in dollars computed on this investment gives the percentage of return.

Neglecting the importance of earnings on investment has always been hazardous and now it borders on business sabotage. Its computation is now a "must" because with war restrictions and high taxation, every angle of operation must be checked and re-checked to make sure that loss-leaks are eliminated and profits kept at maximum. The electrical contractor may go far astray if he stakes his all on the net profit on sales today, insofar as business analysis is concerned. War restrictions are depressing volume or margin and the general remedy is to cut expenses to offset this trend but even the contractor able to cut expenses in ratio to sales equal to the average before the war should not be too cocky about it unless the earnings on investment are satisfactory. The investment may be high and the decrease in dollar volume may show unsatisfactory earnings on investment even though the percentage of profit is up to average.

For example, one contractor had a volume of \$225,000 in 1942 and earned 6 per cent net profit, or \$13,500. His net worth was \$300,000, so the \$13,500 net profit on sales gave him 4½ per cent profit on capital investment. War restrictions cut his volume this year to \$180,000, he effects economies and manages to net the same percentage of profit as in 1942, but 6 per cent of \$180,000 is \$10,800, and his net worth or capital investment is now \$313,500, because it has been increased by the \$13,500 net profit earned in 1942. That \$10,800 net profit earned in 1943 computed on \$313,500 investment gives only 3½ per cent return, a decrease of about 22 per cent in dollar earnings on invested capital. If the downward trend in sales volume, dollar volume or margin continues, the earnings on investment will decrease further, and it is this percentage, the return on the capital invested in your business that is a better gage of managerial efficiency and financial stability today than the net profit on sales.

The contractor who is over-capital-
(Continued on page 88)

JOHN Q. BLANK ELECTRICAL CONTRACTOR Profit and loss statement			
1942		1942	
Sales.....	\$150,000	100%	
Cost of sales—labor, materials, direct job expense.....	90,000	60	
Margin of profit on 1942 sales.....	\$60,000	40%	
Overhead expense.....	54,000	36	
Net profit on 1942 sales.....	\$6,000	4%	

BALANCE SHEET			
1942		1942	
Assets		Liabilities	
Cash on hand and in bank.....	\$8,500	Accounts payable.....	\$3,000
Receivables.....	28,600	Net worth.....	200,000
Inventory.....	10,000	(\$6,000 is 4% profit on sales totaling \$150,000 but only 3% profit on capital investment)	
Business property.....	130,000		
Furniture and fixtures.....	5,000		
Working tools.....	6,000		
Trucks.....	7,500		
Other assets, including goodwill.....	7,400		
Total assets.....	\$203,000	Total liabilities.....	\$203,000

Although 4 per cent profit on sales may be satisfactory for the duration, 3 per cent profit on investment may bring the sheriff or put the contractor in such a financial hole that he cannot expand and promote sales adequately during the postwar period. Many contractors do not appreciate the importance of seeing that the net profit on sales provides an adequate return on capital investment. This statement shows that 4 per cent net profit on sales is only 3 per cent profit on \$200,000 investment. Were this investment \$400,000, the return would be only 1½ per cent. The return on investment must be considered as well as the profit on sales. You may earn a substantial percentage of net profit on sales, yet, the return on your investment may be poor.

The difference between the assets and the liabilities, or the net worth, as shown on balance sheet, can be considered capital invested in your business.

TABLE I

Polarity of brushes for clockwise armature rotation motor or generator, commutating pole A on vertical centerline. See Fig. 1.

App.	Type of Winding	Polarity of Brush on Centerline of South Pole	Polarity of Main Field Coil - S-1	Polarity of Commutating Coil - A
Motor	Lap Progressive	Positive	South	North
	Wave Retrogressive	Positive	South	North
	Wave Progressive	Negative	South	North
Generator	Lap Progressive	Positive	South	South
	Wave Retrogressive	Positive	South	South
	Wave Progressive	Negative	South	South

TABLE II

Polarity of brushes, for counter-clockwise armature rotation, motor or generator, commutating pole A, on vertical centerline. See Fig. 1.

App.	Type of Winding	Polarity of Brush on Centerline of South Pole	Polarity of Main Field Coil - S-1	Polarity of Commutating Coil - A
Motor	Lap Progressive	Negative	South	South
	Wave Retrogressive	Negative	South	South
	Wave Progressive	Positive	South	South
Generator	Lap Progressive	Negative	South	North
	Wave Retrogressive	Negative	South	North
	Wave Progressive	Positive	South	North

Polarity of D-C Field Coils # 2

FIELD COILS

When commutation coil is on center line — second in a series of articles on the polarity of field coils.

By A. C. Roe,
Design Engineer

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

IN the preceding article, sketches and tables indicated armature rotation and brush polarity, for a main field coil located on the vertical center line. This article will contain the same data for machines in which the commutating coil is located on the vertical center line. The main field coil is now to the left, or clockwise, from the commutating coil, A.

By consulting the sketch and tables in this, and the preceding article, any major magnetic, mechanical or electrical item in a motor or generator can be checked. It will be noted that in both cases the brushes are on the center line of a main pole. This means that the armature coils have an equal throw in both top and bottom leads. This causes a 45 degree shift in the brushes between a machine with a main coil on the vertical line and a machine with a commutating coil on the vertical line.

Standard Winding for Basic Coil

The preferred standard clockwise winding for coils made from wire and built up by turns and layers is start-on-

right on the frame side. (The starting lead of the coil is lead D as shown in Fig. 2 (a) and (b) in the preceding article.)

The next alternate is to wind the coils start-on-right on the armature side, but arranged for counter-clockwise winding. In this case the finishing lead of the coil is lead D.

Thus, the basic fixed coil can be termed of south polarity, start-on-right, starting lead on frame side, clockwise winding, and lead D the starting lead of the coil.

The next step is to determine the direction of rotation desired for the arma-

tures of motors and generators. This governs the brush polarity, commutating-pole polarity, the type of armature winding and whether the winding should be progressive or retrogressive. This is shown in Tables I and II.

Clockwise armature rotation (direction determined from the front or commutator end) is standard for railway motors and generators, for mine locomotive motors and for large direct-current motors and generators. However, the majority of direct-current motors used for industrial plants, use the counter-clockwise armature rotation as standard.

All railway, mine, crane, mill, and many industrial motors are operated with the armature frequently reversing direction, but the connecting diagrams are laid out for one standard method, as described above. This provides a standard from which to work in all cases.

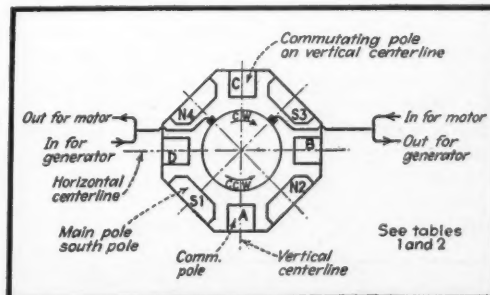
Polarity of Commutating Poles

Another factor that must be considered for motors or generators using commutating poles, is the polarity of these poles as compared to the main-pole polarity and armature rotation.

The polarity of commutating poles for various conditions are shown in the

[Continued on page 114]

FIGURE 1 — Standard brush polarity for clockwise or counter-clockwise armature rotation, motor or generator, lap or wave windings. Commutating pole is on vertical center line of frame.



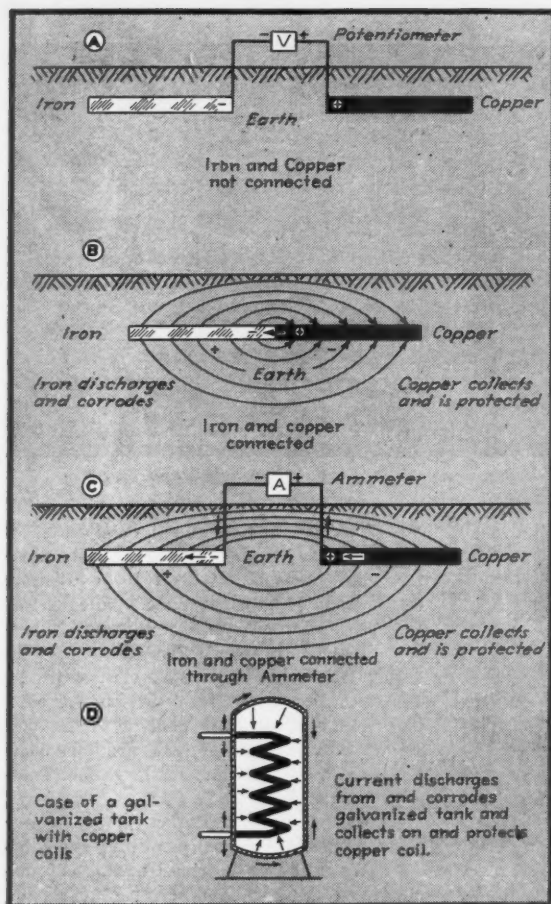


FIG. 1—GALVANIC ACTION is illustrated by the following sketches: (A) iron and copper placed in soil and not connected will generate an open circuit galvanic voltage as measured by a potentiometer; (B) when connected, galvanic currents are produced causing iron to discharge and corrode and copper to collect and be protected; (C) iron and copper short circuited through an ammeter to measure the galvanic current in the metallic circuit; (D) a common example of electrolysis in a galvanized water tank where tank corrodes and copper pipe receives deposits.

ELECTROLYSIS as used in this work may be defined as the decomposition or wasting away of a metallic body, such as a pipe or a metal cable sheath, by the action of a positive direct current flowing between the metal in question and surrounding moisture (ordinarily the moist earth). All corrosion is caused by electrolysis in a broad sense but some investigators have narrowed it down to mean corrosion due to manufactured electricity—such as stray currents from electric railways, stray Edison (d.c.) currents, stray d.c. welding currents and the like.

Corrosion on pipes, cable sheaths or any type of metallic structure in which

there are no "stray currents," is caused or accompanied by natural direct currents in some form. These natural currents are sometimes called "galvanic currents," especially when they are generated by a "couple" composed of two dissimilar metals in contact in an electrolyte. One example is a copper pipe and a metallically interconnected black iron or steel pipe laid in moist soil. In this case the copper will form the positive (+) side of a battery, the iron the negative (-) side. The iron will discharge current to the soil and corrode while the copper will collect current from the soil and will not corrode.

Likewise, a galvanized iron pipe and a black iron pipe will set up a similar battery. In this case the black iron will be positive (+) the galvanized iron

negative (-) and the galvanizing will waste away. After the galvanizing is gone, the reaction may even reverse.

Why does the negative (-) member, such as iron in a galvanic couple of iron and copper, corrode rather than the positive (+) member, since it is a positive condition to surrounding earth which causes corrosion? This can be explained by this fact: if pieces of iron and copper are placed in soil and not connected, there will be an open circuit galvanic voltage between them which can be measured with a potentiometer, with the iron being negative and the copper positive (See Fig. 1-A).

Now, if the iron and copper are connected and placed in the soil, which is equivalent to short circuiting a battery cell with a heavy conductor, the iron will

CORROSION

A discussion of underground metallic structure deterioration due to natural galvanic action, stray currents and ground returns.

By Robert J. Kuhn
Consulting Engineer, New Orleans, La.

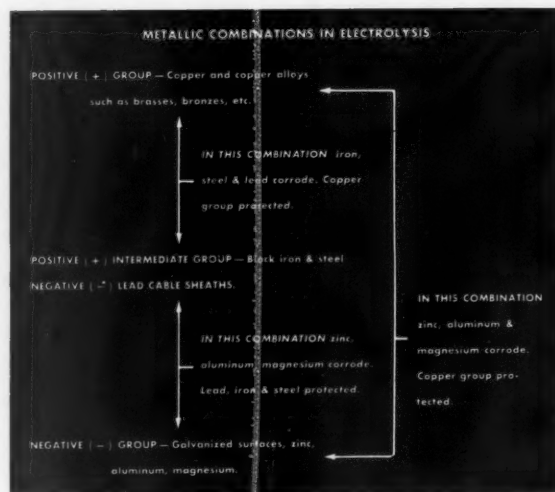


FIG. 2. METALLIC COMBINATIONS with the result of electrolysis on each metal is indicated in the above chart.

*From a paper presented at the Southern Section, IAEI Convention in New Orleans.

N and ELECTROLYSIS



ROBERT J. KUHN, consulting engineer, New Orleans, La.

be raised somewhat in potential making it become positive (+) to the surrounding soil while the copper is lowered somewhat in potential becoming negative (-) to the surrounding soil. The copper, however, is always positive to the iron if only by a fraction of a micro-volt as measured in the metallic part of the circuit (See Fig. 1-B).

The iron, while short circuited with copper being positive (+) to soil, discharges current to the soil and corrosion takes place. The copper, while short circuited with iron being negative (-) to soil, collects current from the soil and is protected from corrosion (See Fig. 1-C). In the metallic part of the circuit current flows from the copper to the iron, for in this position of the galvanic circuit the flow is just the reverse from that in the soil.

Accordingly the various metals may be arranged into general groups, one group of which will attack the next group and so on (See Fig. 2).

Electrical values in such combinations are of the order of several tenths of a volt and currents may range from micro-amperes to 10 or more amperes, depending upon the area of metal involved and other conditions.

In addition to galvanic currents gen-

erated between various metals, local galvanic currents may be generated between various parts of the same metallic structure. These are due primarily to differences in the surrounding soil or moisture, rather than to differences or impurities in the metal. In fact, most of the corrosion experienced on underground pipes, cable sheaths, conduits, etc. is probably due to this type of action in one form or another, rather than to action of stray currents or galvanic currents from dissimilar metals.

How to recognize and overcome these situations is a science almost unto itself. The best the operating man can do is to follow standard procedure in pipe and cable installations unless the project will warrant the services of an electrolysis engineer. Much depends upon local conditions and local past practice. Some sections report generally good conditions as far as corrosion is concerned. The fresh water Great Lakes Area is a good example in contrast to the salt water Gulf and other coastal areas where corrosion is generally severe. Cinder fills are notorious as a cause of corrosion and are to be avoided whenever possible. Even lead cable sheaths as well as all other metals are badly attacked by cinders. Sewage seems to attack lead sheaths as

well as other metals. Generally speaking, clean sandy soils are less corrosive than the thick gumbo clays which often abound in decayed vegetation, and soluble salts.

Electrolysis due to stray currents has been largely associated with electric street railways which usually operate on a 600 volt d.c. circuit, using the rails as a negative return. Stray current electrolysis can also be caused by stray welding currents, telephone battery circuits, battery charging operations and other causes. It is to the interest of the street railway utility to regulate its return currents for protection in reducing return

[Continued on page 104]

FIG. 3—ELECTRIC SHIP WELDING with generator grounded to piping system causes dangerous electrolysis condition. Separate ground returns to each welding generator will alleviate condition (note dotted return).

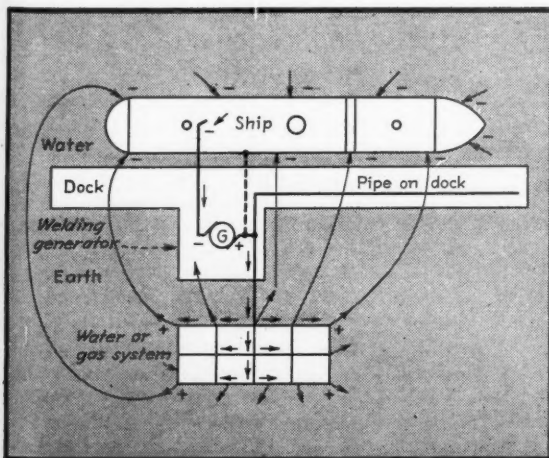
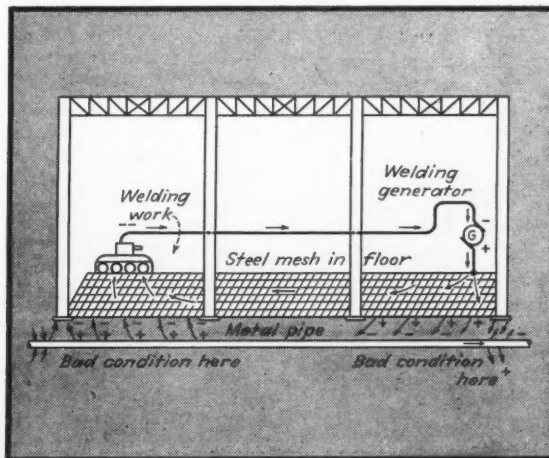


FIG. 4—STEEL MESH GROUND RETURN embedded in floor for large area electric welding operations will set up electrolysis between the mesh and surrounding metallic structures and piping systems.



EDITORIALS

W. T. Stuart, *Editor*

Million Homes A Year

The Market Analysis Committee of the Producer's Council has predicted 16 billion dollars of construction volume annually for the five year period after the war. This is probably the most optimistic forecast that has yet been made but it is the total of a careful and methodical study by a committee of construction men for industry guidance in setting plans for the future. It is probably as nearly accurate as any predictions today can be.

The largest percentage increase will come in commercial construction, the report predicts, which should reach a volume of slightly less than two billion dollars a year. The greatest single item, however, is residential construction which it is predicted will reach 970,000 new dwelling units or about 6.4 billion dollars a year. This is 11 percent greater than the peak period 1923-27 and exceeds the 1936-40 average by 111 percent.

Reducing that housing prospect to electrical work gives us some startling figures. At \$150 per home or dwelling unit (which would not be off the pre-war average) it would total 145.5 millions of dollars in house wiring. A vigorous wiring campaign should be able to easily double the average wiring budget for postwar housing. That would leave a round figure of nearly 300 millions of dollars a year for *house wiring*.

The indifference of well established, well financed and adequately staffed electrical contractors toward house wiring has been one of the serious problems of wiring promotion. Their vigorous active cooperation in postwar housing is essential if we are to build new standards and eliminate wiring bottlenecks in electrical progress.

The NECA-IBEW postwar plan recommends that in every community there should be responsible contractors prepared to handle house work including repairs and alterations on the most efficient basis possible and urges the cooperation of established contractors in setting up such organizations if necessary. The labor unions are to

cooperate with appropriate wage rates.

The tremendous market potential in postwar house wiring will certainly invite the attention of able business men from other industries. Let's hope they will find the market already well established in the hands of equally able business men with long experience and know-how in the electrical construction business.

Electronics Training

An editorial on this page last month about a course in electronics organized by a group of Chicago electrical contractors has brought in some interesting comments among which is a letter from J. J. Crawford, Assistant to the Director of Temple University in Philadelphia.

Quoting Mr. Crawford, "It may be of interest to you to know that under the Engineering, Science and Management War Training program we have at the present time in training some 900 men and women, part-time, day and evening, in electronics. Approximately 100 of these people are taking what we call Applied Electronics II, Industrial, which is in line with your editorial."

That latter course, incidentally, requires two nights a week, three hours a night for 12 weeks. It is significant of the way that men are applying themselves in many communities around the country so that they will be ready for the inevitable developments in industrial electronics. It is a good sign. And it is symptomatic of important advances in our industry.

Consumer Needs Under Investigation

A consumer survey has been under way for the past few weeks to determine the availability of 115 types of goods and services used in homes and on farms. The survey is under the direction of the Office of Civilian Re-

quirements of which WPB Vice Chairman, Arthur D. Whiteside is the head.

The survey will be conducted on the scientific cross-section principles, taking methodical samples in each income group, geographic area and similar divisions of the population. It is designed to get the answers to four questions:

1. What shortages are causing hardships?
2. What items are most needed?
3. Are available supplies being distributed fairly?
4. What durable goods, such as appliances, are in use and what is their condition?

The data obtained will be used by OCR in its function of maintaining adequate supplies of civilian goods and services within the necessary limits of wartime conditions.

This is an excellent project and one which should be repeated periodically to gather information under the rapidly accelerating replacement needs. Electrical appliances and materials for electrical repairs have been critically scarce for a long time. If such surveys can uncover immediate wants and open the way to relieving them it will avoid a serious piling up of critical needs to a point where the condition of appliances and wiring create widespread danger to the public.

And Repairs Are Important

Next month a campaign for "Better Care-Less Repair" will be inaugurated on a national scope to help keep an estimated 200 million electrical appliances functioning for the duration. It will be sponsored by the Edison Electric Institute in cooperation with manufacturers, wholesalers, dealers and utilities.

The campaign will emphasize appliance care, telling the housewife what she can do and what she should not do to extend the life of her precious household equipment. It also opens the way for making minor repairs be-

fore major repairs become necessary.

Tying in, as this program does, with other major national conservation plans it deserves close industry cooperation and the help of those government agencies controlling the availability of critical materials. It has the blessing of J. A. Krug, Director, Office of War Utilities and Arthur D. White-side, Vice Chairman for Civilian Requirements, WPB. A very small expenditure in manhours and materials can keep this enormous resource of vital household machinery in working order.

Dimout Lift Cuts Deaths

The dimout regulations which kept coastal areas under virtual blackout conditions were lifted last month under strong pressure from civic groups. The successful campaign against enemy submarines operating in coastal waters has removed the urgent need for eliminating the sky glow against which they once spotted their merchant vessel victims.

The dimout gave protection to coastal craft at a terrific cost in accidents and crime to the cities required to carry on under the enforced darkness. If ever the electrical industry wants proof of the vital civic protection provided by adequate street and highway lighting the statistics of dimout deaths will show plenty. The immediate drop in crime and accident figures on November 1 in New York City alone is both startling and significant.

When we go out to sell decent civic lighting it is usually against an argument of cost. The dimout experience ought to prove, for once and for all, that good lighting doesn't "cost". It is actually a measure of social economy.

Dashboard Instruments For Machinery

How important electrical instruments are to a bomber crew is obvious to even the casual observer. Every man at his post has a panel of instruments gathering and reporting information about the critical conditions in and around his complicated craft.

Mechanized warfare has high-lighted the importance of indicating instruments. Are we willing, however, to

take a lesson from their use? This industry of ours has always had a blind spot in the application of instruments that is hard to understand. It has never troubled the automobile people. They have always given us a neat panel of indicators telling at a glance about the various important things we ought to keep track of in driving.

But does the operator of a lathe, or a printing press or a hoist have any such facilities? None that we have seen. Yet most of the things he ought to know, torque, speed, load terminal voltages and so on are usually reflected in the circuits operating the motor and consequently can be easily represented on simple indicating instruments which are rugged, accurate and inexpensive.

It seems to us that there is a field of application for indicating electrical instruments in industry, and wherever electric motors and controls are used, that has never been effectively explored. The rapid development of miniature instruments in recent years has made it entirely practical to apply them to machinery as generously as the convenience of the operator requires. Indicator panels ought to be as much a part of an electric motor installation as the control station.

Does Light Reduce Accidents?

It is usually impossible to nail down the exact causes of individual industrial accidents. We have long known in a general way, that adequate lighting will reduce accidents but to prove that perfectly logical argument is not easy.

The Better Light-Better Sight bureau has just published a series of studies, however, which proves the point by correlation. A group of factory areas recently relighted were analyzed on the basis of injury statistics. Each one showed a sharp decrease in accidents or first aid cases after relighting.

The statistical method showing accident declines is never very dramatic. But to the scientist or the well informed student of accident prevention there can be no more effective case drawn for better lighting than one showing a significant decline in the ratio of first aid cases to number of employees after relighting.

The BL-BS report is an important contribution to the evidence in our continuing attack on inadequate industrial illumination.

Washington Notes

► Unofficial estimates of how long the European phase of the war will last is now (mid-November) averaging out about mid-February. On-the-record pronouncements by military officials decry such optimism, denounce "all this postwar talk" and warn that more sacrifices, civilian and military, are ahead. Behind the scenes, however, department heads in WPB are having difficulty holding key men in bureau jobs, who want to get back to their business responsibilities. The realization that an orderly withdrawal of war controls on industry and commerce is second only to winning the war in national importance may hold many top men, however optimistic the military reports become.

► The number of labor market areas of acute labor shortage (Group I) rose to 77 as of November 1. The crest of the labor shortage problem is approaching but labor observers express some concern over the prospects in three to four months.

► Any hopes of relaxed construction rules in the immediate future were quashed by a recent statement confirming the policy "to restrict construction—to the minimum necessary—", and to seek a minimum consumption of materials and manpower, together with maximum utilization of existing facilities.

► Supplies of aluminum, copper and steel are all reported easier. How much the improvement will affect industries working on essential civilian goods will be determined largely by what labor saving can be effected by more liberal allotments.

► Total volume of construction activity in the United States in September was \$526,502,000, a drop of 13 percent from the August level. The September figure brings the total for the first three quarters of the year to \$6,338,000,000.

Expansion of government-financed industrial facilities (construction volume and machinery and equipment deliveries combined) totaled \$274,260,000, making the total for the first three quarters of this year \$4,128,000,000 of which over half or \$2,292,000,000 was for machinery and equipment.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

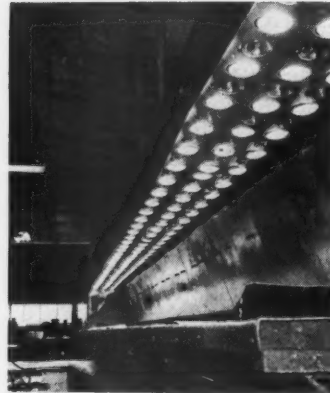
PRACTICAL METHODS

INFRA-RED VERSUS MOISTURE

INDUSTRIAL

In the fabrication of various rubber products required by the armed forces, it is necessary to paint or spray a layer of cement on the successive layers in order to provide the required adhesion. Under high humidity conditions, the temperature drop, caused by the evaporation of the solvent in the cement, precipitates "dew" on the freshly cemented surface. This results in blisters in the finished product. The problem is to quickly dry this cement and evaporate any moisture present at the same time.

As a first venture, when Hood Rubber began manufacturing rubber war goods, a spraying table was provided with a five sided enclosure, the back side being slotted the full length, four inches wide at the table level. Duct connected the slots to the outside atmosphere and suction fans were used to draw the air across the surface of the table and out, taking the moisture with it. However, enough moisture remained



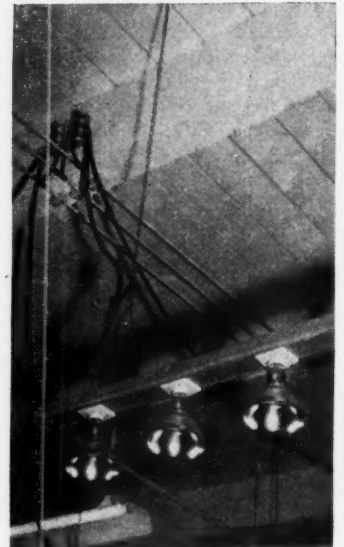
INFRA-RED LAMPS are fed from 3 phase, 575 volt feeders. The lamps are split up alternately on two circuits, each provided with a three pole, single throw, manually operated switch. Five lamps are connected in series across 575 volts and so arranged as to give balanced three phase operation.

to give an unsatisfactory rubber layer.

So in the ceiling of the enclosure, a bank of 225 infra-red lamps were mounted three feet from the table surface. The lamps, which were rated

115 volts, 250 watts, were connected five in series across 575 volts, which is the plant distribution voltage. The lamps are split alternately on two circuits so that depending upon the humidity and speed of drying desired, half or all can be used.

The lamps are mounted in three rows, eight inches apart with a longitudinal

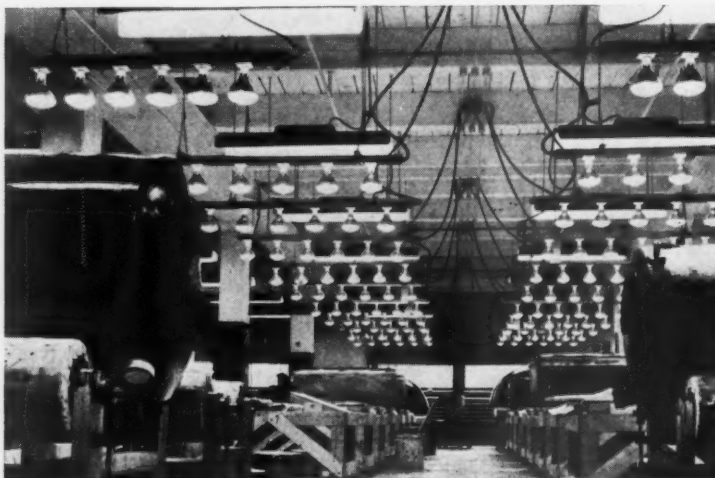


SILVER REFLECTOR infra-red lamps are mounted in Curtis strip with the switch attached to the end so that individual banks of six lamps may be turned on and off as required. Fuse blocks are mounted on the wooden structural beam directly above the open run of 115/230 volt 3 wire feeder.

spacing of eight inches. Circuits are run in standard Curtis strip and a thin-gage steel reflector directs the rays to the work.

Another instance where infra-red solved a production problem easily, quickly and economically is in Hood Rubber's self-sealing gas tank department. Here the problem was the same—that of quick drying with the elimination of moisture as layers were cemented.

Over each assembly jig is mounted



MOISTURE IS REMOVED from the rubber layers by individual six-lamp infra-red banks. The application is made in the self-sealing tank department where localized heat is required to remove moisture and speed drying.

That *Postwar Vision* may be clearer

FLUORESCENT lighting will bring better vision to postwar office and home, just as it does to war plants now.

Under the pressure of war, quality research has been accelerated and extended to every phase of fluorescent lamp manufacture.

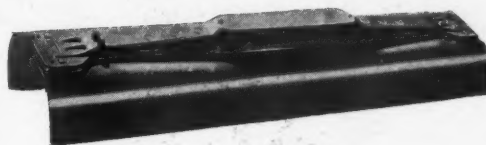
For example, it is true that the more immaculate the glass in a fluorescent lamp, the more light you get. Therefore, Sylvania has developed an improved lamp cleaning process.

Sylvania lamps now pass through two steaming hot baths of constantly changing water, in chemically treated ceramic vats. Thoroughly washed in the first, they are rinsed in bubbling, aerated water in the second. Any surviving dust is removed with power-driven, non-linting nylon brushes.

This meticulous care produces a superior inner surface for coating that distinguishes Sylvania Fluorescent Lamps.

The result is the best and most economical artificial light known — cool, glare-free fluorescent light.

Recommend Sylvania Fluorescent Lamps for replacements and new installations.



THE FIXTURE OF THE FUTURE

This model HF-235R fluorescent fixture rounds out Sylvania's industrial line. Its two 100-watt fluorescent lamps in Sylvania's non-metallic reflector give maximum lighting intensities with a minimum use of critical materials. (Reflector efficiency of 86%.) Streamlined top housing provides for complete hanging flexibility and encloses the ballast for protection.

★ **SYLVANIA** ★

ELECTRIC PRODUCTS INC.

500 FIFTH AVENUE

NEW YORK 18, N. Y.

INCANDESCENT LAMPS, FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, RADIO TUBES, CATHODE RAY TUBES, OTHER ELECTRONIC DEVICES

Electrical Contracting, December 1943

a bank of six infra-red lamps on from 6-inch to 10-inch longitudinal centers. Here the lamps are of the same rating 115 volt, 250 watts, but are connected in parallel. A total of 63 kw. in lamps are fed from a 50 kva. transformer 575 volt to 115/230, three wire, single phase. Temporary type SB wire is used throughout. Open wiring on porcelain cleats feed four-circuit porcelain fuse blocks, to which each bank of lamps are connected. Each bank is separately switched so that they can be turned on individually after the operator has finished cementing. The load diversity factor is such that the 50 kva. transformer handles the load very nicely.

GRINDING COLLECTOR RINGS

INDUSTRIAL

As a result of the Carnegie-Illinois Improvement Record System for simplification of maintenance procedures, the time for grinding collector rings has been cut exactly 50 percent. Further, 440 volt shock hazard to the employee has been entirely eliminated.

Originally, air ducts had to be removed from the collector end, and brush holders transferred to a temporary yoke. The grinding equipment was then set up and rings were ground as the rotor revolved under its own 440 volt power. This job required two men to work 16 hours under conditions of possible shock.

These large wound rotor motors are used to drive hydraulic pumps which supply the mill with large quantities of

process water. Several such pumps feed into the same main line header through a check valve. It occurred to one of the maintenance personnel that if the check valves were removed, the feed-back pressure would revolve the rotor in reverse so that grinding could be done without the use of electric power. This would not only remove the possibility of shock, but would also save the time required to dismantle and reassemble temporary brush rigging.

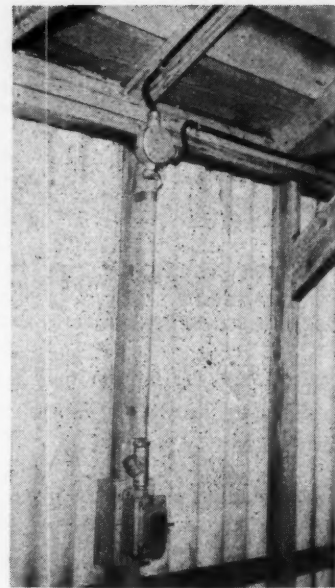
The procedure was proposed through the Improvement Record System and was immediately adopted. The operation has now been reduced to a two man, eight hour job and the employee need no longer work under the strain caused by shock hazard.

At the same time this procedure was put in effect, it was decided that no more grinding was to be done with motors operating under their own power. On all other drives, other than where feed-back from water pressure could supply the driving power, a gasoline driven winch is used to revolve the rotor. The cable is removed from the winch drum and belted to the shaft or pulley and grinding operations are thus carried on with the elimination of electric power from the collector rings.

WOOD RACEWAYS RETURN

WIRING

Wood raceways for the mechanical protection of electrical circuits are returning, to a limited extent, as a result of the wartime limitation on the use of steel conduit and the relative difficulty

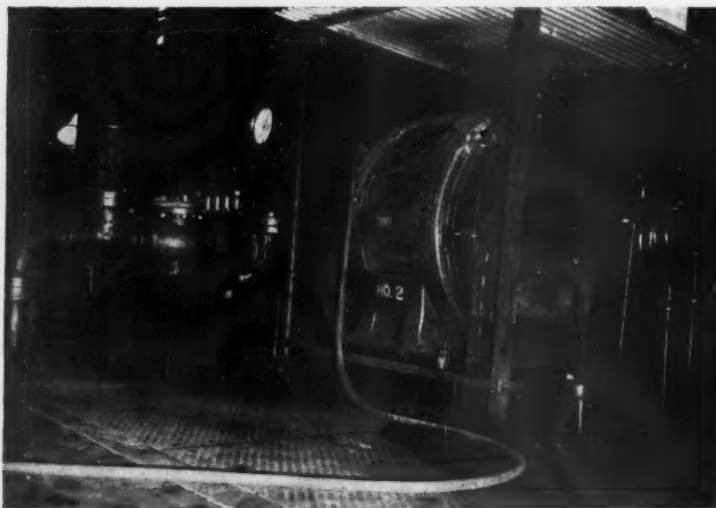


PROTECTED AGAINST mechanical injury, non-metallic sheathed cable switch legs in this ordnance plant are encased in half-round wood molding strips. Duration type wiring is designed to eliminate critical materials.

in obtaining metallic raceways. We are all familiar with the channeled wood molding used years ago to cover exposed electrical conductors. It is back, serving as an emergency substitution.

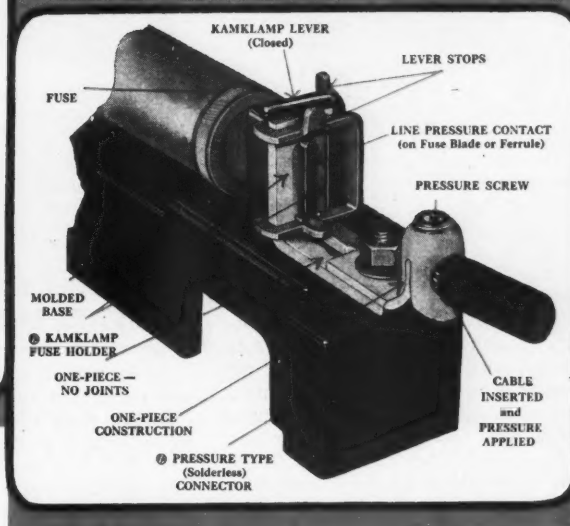
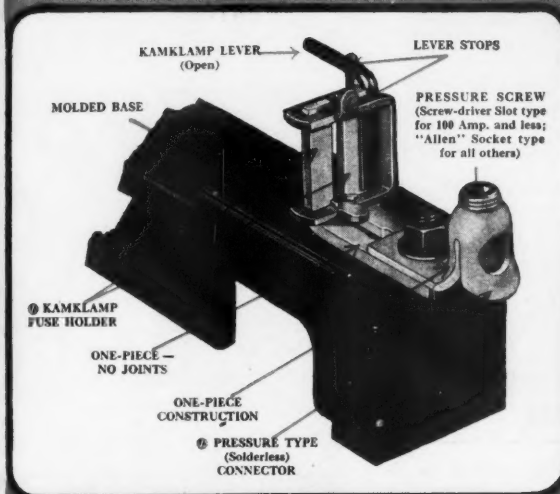
One example of its use in an unusual location is at the Oak Ordnance Plant in Illinois. Rushed to completion to pour out ammunition for the armed services, this duration plant is constructed of a minimum amount of critical materials. To hurdle material difficulties, the interior wiring system is of the non-metallic sheathed type with explosion-proof outlets and equipment. Since the hazardous condition consists of powder dust in the atmosphere, without the presence of any explosive gases or vapors, the engineers specified readily available non-metallic sheathed cable for the circuit work. The dust cannot penetrate the outer covering of the cable and all conductors within it are thoroughly insulated, including the neutral.

Wherever non-metallic sheathed cable switch legs are, of necessity, mounted on the outer surface of wood supports or in any portion where they might be contacted by workers, the cable is protected by a strip of half-round wood molding. This protective sheath extends from the junction box above the switch leg to the explosion-proof sealing fitting attached to the outlet box. All junction boxes receiving non-metallic sheathed cables have hubs equipped with special rubber grommets.



SLIP RINGS of wound rotor motors such as this driving hydraulic pumps are ground as the rotor revolves under water pressure. The check valve, through which pumped water is dumped into the main line under normal operation, is removed and back pressure spins the rotor in reverse during grinding operations.

• a Tightly held Fuse means A MORE PERFECT CONNECTION



THE INGENUOUSLY DESIGNED KAMKLAMP FUSEHOLDERS ON



SHUTLBRAK Switches



100 Amp.
575 Volt
Shutlbrak
Switch-Cut.
No. SA-10633

MAINTENANCE NOTE

All electro-mechanical apparatus requires intelligent maintenance to produce the most satisfactory service. You will find helpful our free booklets on "Maintenance."

clamp the fuses tight. Insert the fuse—turn the lever—and you have a copper-to-copper connection under strong and continuous pressure.

Convenient, too, are the Pressure Type (Solderless) Connectors, which make possible quick, sure connections with both line and load wires or cables—connections which will not "ease up" or become loose.

Because of these and other outstanding advantages, plants producing war materials have purchased thousands of these switches. Some are used singly—others are banked in groups—or assembled in well-designed switchboards or panelboards. Still others are installed as plugin units for Busduct.

But wherever and however used, this heavy duty industrial switch is giving efficient, dependable service—on motor circuits—at service en-

trance—and on installations requiring an operating switch.

Shutlbrak Switches are available for both surface and flush mounting. Installation and connection are expedited by the ample wiring space at top, bottom and at rear of the switching mechanism, and by the conveniently placed knockouts.

Capacities: 30 to 1200 amperes, inclusive, for 250 volts AC or DC, and 575 volts AC, in 2, 3 and 4 pole types. Approved by Underwriters' Laboratories, Inc.

For Detailed Information

and suggested specifications for Shutlbrak Switches, Panelboards and Switchboards, write for Bulletin No. 70 . . . Frank Adam Electric Co., Box 357, St. Louis, Mo.



UNDERGROUND PUMPING STATION

INDUSTRIAL

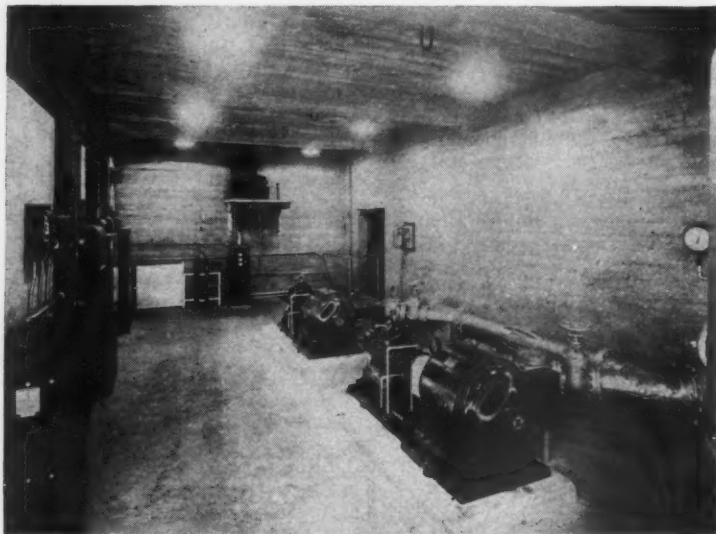
Army camps are in reality self-contained communities—the population of some reaching city proportions. Water supply is a dominant factor, some camps being fed by miles of underground pipe line.

Booster pumping stations are an integral part of the design of such systems. In one such installation at a California camp, the booster station was built underground and designed to deliver 1,350 gallons per minute at a total dynamic head of 760 ft., through approximately eight miles of 16-inch steel pipe, to an elevated storage tank.

The station has two pumping units, each driven by a 200 hp., 440-volt, 3,550 rpm. squirrel cage induction motor direct-connected to a two-stage pump delivering 675 gpm. Piping arrangement is simplified by having suction and discharge nozzles on the same side.

Sixty cycle, three-phase alternating current is delivered to the underground booster station at 33,000 volts and stepped down to 440 volts for motor supply. Electrical equipment is mounted on the wall opposite the pumping units with concealed branch circuits feeding the motors and auxiliary equipment. A 75 kva. capacitor unit saves several dollars per day in power costs by boosting the power factor of the pumping station electrical system.

Good lighting intensity for maintenance and repair activities is provided by incandescent RLM reflectors mounted to outlets concealed in the concrete roof slab.



PRESSURE BOOSTER—This underground pumping station boosts water supply pressure to fill storage tank at army camp eight miles away.



THIS PUNCH PRESS was bought for the specific use of the copper shop where all the copper bus was handled in the wiring of the New York City Aluminum plant. So many identical pieces were handled that dies and jigs were set up and the pieces punched in mass production style.

CUSTOM-BUILT SWITCHBOARD DISTRIBUTION TROUGH

WIRING

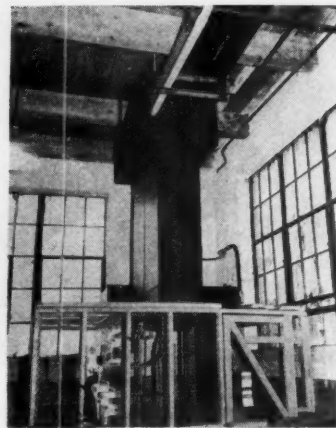
To increase flexibility, and to facilitate installation and maintenance, Phil Caminiti, plant electrical engineer for Brewster Aeronautical Corporation in New York City, has designed a distribution trough to carry circuit conductors up and away from one of his main distribution switchboards.

The purpose was to eliminate "wrestling" 10 or 12 3-inch conduit drops to the back of the board. Further, a maze of tangled circuits and cable crossovers has been eliminated. In the event additional circuits are required, it is a simple matter to terminate the extra

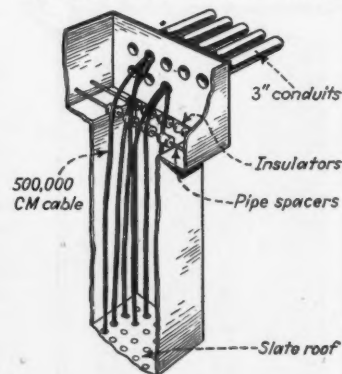
conduits into the large overhead pull-box. The cables are then dropped through the trough to the respective switch terminals. All crossovers are made in the trough and at the bottom, the cables are threaded through a slate roof drilled to accommodate the 500,000 cir mils cable used for distribution.

The cables emerge in orderly groups and run to the proper terminals giving a very favorable external appearance.

The trough is made of thin-gage sheet



WIRING TROUGH carries cables to distribution board from pull-box overhead. Thus conduits terminate above. Crossovers of cables are made in trough enabling a straight run to switch terminals. Double-tier conduit hangers are made from angle iron and spaced on hanger bolts by short pieces of pipe.



THREE PHASE CONDUCTORS are laced to insulators carried on bolts and spaced by short pieces of pipe. All crossovers are made in the trough and cables are brought out through the slate roof at the bottom. This enables an orderly external appearance of cable arrangement.

steel and rises up into a pull-box of larger dimensions. Welded construction is used in fabrication. The end of the pull-box opposite to the incoming conduits is removable to allow entrance for threading additional cables through the slate roof and pulling new circuits.

[Continued on page 107]

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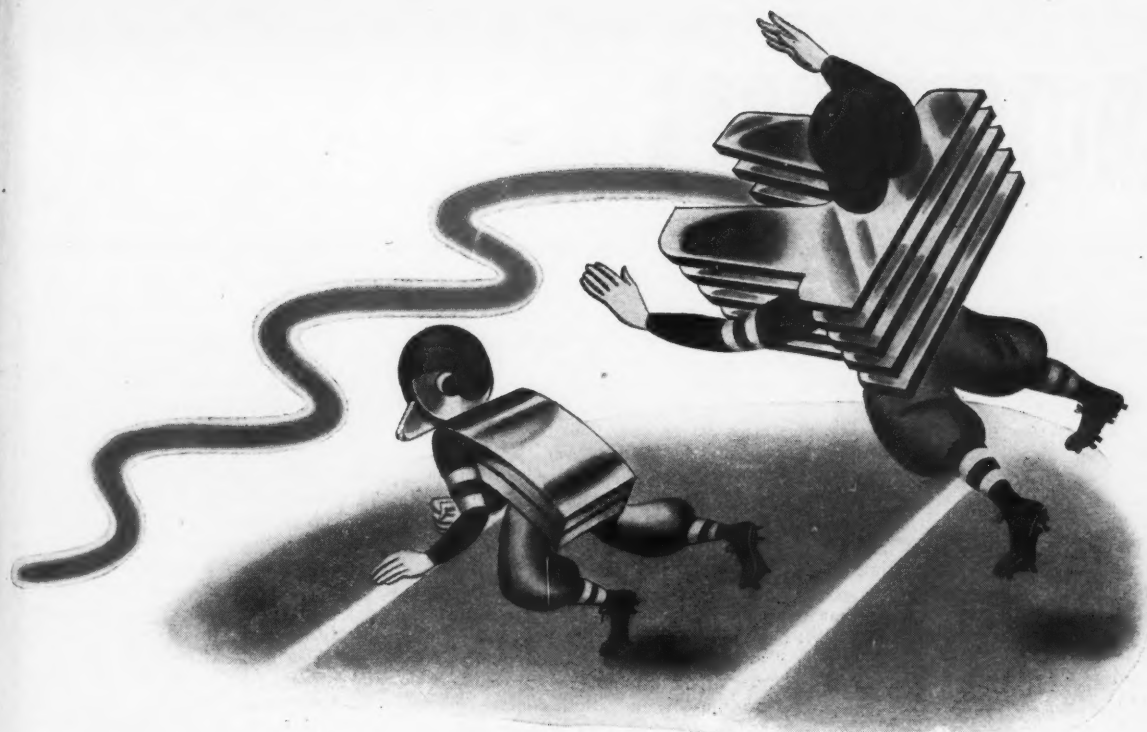
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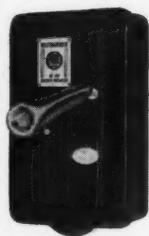
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When Current Kicks... It's Blocked, *Quick!*



You get split-second protection when Westinghouse "De-ion" Circuit Breakers guard your vital electrical circuits. This protective device goes into action fast; opening the circuit and quenching the arc . . . when danger threatens. Here's how it works.

The Westinghouse Bi-metal element reacts to heat. Momentary, harmless overloads are passed without interruption. But, let the disturbance threaten . . . and the Bi-metal bends, trips the mechanism, opening the circuit.

Instantly the resulting arc is quenched. Drawn into the "De-ion" arc quencher, it is divided and smothered, in half a cycle. Arc burns and pits are minimized. Contacts stay clean, last longer.

And service is easily restored. Once the disturbance has been corrected, a simple flip of the indicating handle puts the circuit back in action. There are no parts to repair or replace; no waiting for the maintenance man.

Don't take chances with your vital electrical circuits. Protect them with Westinghouse "De-ion" Circuit Breakers. Available in ratings to 600 amperes, 600 volts a-c; in enclosures for practically every type of service. See your local Westinghouse representative, today, or write Westinghouse Electric & Mfg. Co., Dept. 7-N, East Pittsburgh, Pa.

J-21291



Westinghouse "DE-ION" CIRCUIT BREAKERS

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

Electrical Contracting, December 1943



43

MOTOR SHOPS

ELECTRIC COMMUTATOR SOLDERING DEVICE

The soldering of coil connections to motor commutators is materially speeded up in the motor repair department of Industrial Electric, Inc., New Orleans, La. Time economy on this particular phase of motor repair work is the result of an electrical soldering device conceived and developed by D. E. Adams and M. B. Hutson, shop superintendents of the Industrial organization.

The gadget is really an attachment used with an ordinary Ideal Model 10A soldering tong set. Offset electrodes made of $\frac{1}{8}$ -in. by 2-in. copper bus (see "3" in photo) are connected to the jaws of the tongs and mounted on a common wood base. These bus extensions are hinged near the edge of the base and held stationary by two spring bolts—one for each arm (see "4" in photo). Flexible copper jumpers connect the hinged arms with the soldering tong extensions. Each tension bolt is equipped with two nuts on the under side of the copper arm—one to hold the bolt rigid in the base; the other to adjust the height of each arm for different diameter commutators. The nut on the top

of the bolt is used to vary spring tension.

When in use, the base is mounted at the edge of the workbench by two bolts which fit into holes drilled in the bench top. In this position, the offset copper arms extend over the edge of the bench sufficiently to rest over the center of an armature shaft placed in either a bench-type or portable armature cradle. One arm, equipped with a wide piece of high resistance carbon or copper rests on the horizontal segment of the commutator. The other arm (with the wood handle), equipped with an adjustable high resistance carbon rod with a heat shield, rests on the slotted vertical portion of the commutator segment receiving the coil end. Both contact tips are so aligned that they rest on the same commutator segment thus completing the electrical circuit needed to solder the connection. The spring tension on the bolts ("4" in photo) provide the necessary tension for good contact.

The entire commutator is first preheated with a torch until the solder paste flows freely. Then the electrical soldering device is used with strip solder, permitting the mechanic to make a good, clean connection at each riser slot. As each segment is soldered, the armature

is rotated until the contact points of the bus arms rest on the next segment. The left arm (with the wood handle) is raised while the commutator is rotated. Asbestos tape is wrapped around the coil ends for a distance of $1\frac{1}{2}$ -inches back from the commutator riser to prevent the heat from scorching the armature windings.

Shop experience with this unique device has indicated a saving of about one half hour on a job which formerly took $1\frac{1}{2}$ hours—a saving of approximately one-third. The device does not permanently tie up the tong set. If the tongs are needed elsewhere the removal of three bolts (see "6" in photo) will release the tongs intact. It takes only a few minutes to make the transition.

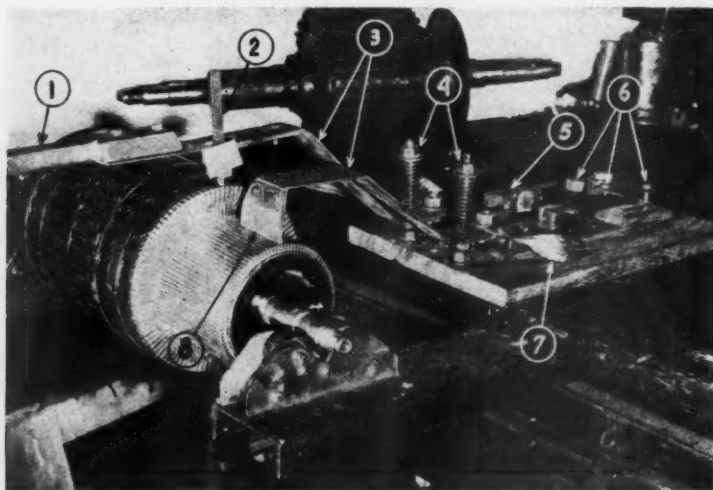
FLEXIBLE GRINDER SPEEDS REPAIRS

Why use hand tools if the job can be motorized? That's one question that George A. Koepp, Koepp Electric Motor Company, Manitowoc, Wis., asks himself as he glances around his motor repair shop. Consequently his shop is loaded with all sorts of labor saving schemes and gadgets.

One of the most useful and universal items is a flexible grinder which he built for his own use. Equipment is hard to get these days, so George gathered together a $\frac{1}{2}$ hp., single-phase, 110-volt, 1800 r.p.m. motor, a flexible shaft with mandrel, a piece of $1\frac{1}{2}$ -inch pipe, some casters and a discarded rear-wheel brake drum from a $1\frac{1}{2}$ -ton Chevrolet truck. Out of it came the portable flexible grinder illustrated below.

The brake drum and casters form the base of the unit. The $1\frac{1}{2}$ -inch pipe with a circular steel disk form the pedestal on which are mounted the motor and control switch. The grinder stands 35 inches above the floor and is equipped with a 5-ft. flexible shaft so it can be used either on small bench work or on large work resting on the floor.

Formerly a lot of hand work was involved in scraping varnish off stator laminations, filing down high spots or filing ridges on welded joints. Now all the mechanic need do is place a wire



ELECTRIC COMMUTATOR SOLDERING device has the following salient construction features: (1) wood handle to raise bus arm; (2) high resistance carbon rod for one contact; (3) offset bus arms; (4) spring bolts for bus arm adjustment; (5) ordinary soldering tong set connected to bus arms; (6) three bolts which hold tongs to base and bus extensions; (7) flexible copper jaw to hinged part of bus arm; (8) contact tip of second bus arm aligned with first to rest on a complete commutator segment.

CROCKER-WHEELER

STALWART, WAR-TIME POWER

American-made motors and generators have met the two and three shift requirements of war industry, with an astounding record of trouble-free performance.

A sizeable proportion of these bear the Crocker-Wheeler name... quite a few of them are older than the operators of the machines they serve. For Crocker-Wheeler motors and generators, for over 50 years, have been carefully and durably built.

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Electrical Contracting, December 1943

Make This Comparison of

"Skilled Lighting!"

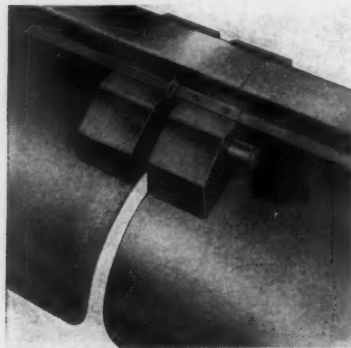


Compare the Wheeler 1943 RLM Fluorescent Fixture with any other fixture made in accordance with latest WPB requirements. Its trim, compact appearance truly indicates its simple, sound engineering, outside and in!

Wiring channels, for example, are hollow steel I-beams combining light weight and extreme rigidity. Provide durable support, easy adjustable suspension, instant access to starter switches.

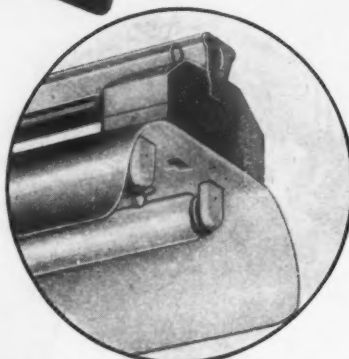
Reflectors, too, are typical Wheeler "Skilled Lighting" . . . designed with the "know how" of 62 years' experience. Made from tough, non-flammable, moisture-resistant material . . . chip-proof, washable enamel, inside and out. Rugged, lightweight, durable. And higher in lighting efficiency than many porcelain-enamelled metal reflectors!

Write for detailed Bulletin 72. Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass. . . . New York City. Representatives in principal cities.

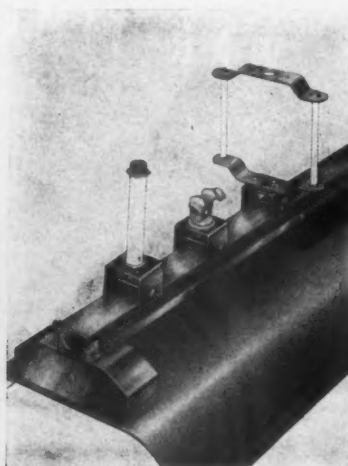


Continuous Installations easily made with speedily-applied couplings. Note accessibility of starter switches.

Distributed Exclusively Through Electrical Wholesalers



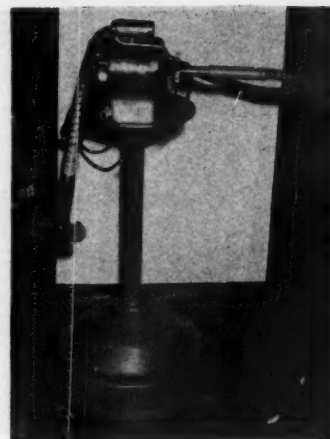
Rigid weight-conserving steel wiring channels. Easily accessible operating parts. Reflection factor not less than 85% gives better than 80% overall efficiency in 48" two-lamp units, 76% in three-lamp units, 74% in 60" two-lamp units.



"C-Clamp" Hangers afford conduit, messenger cable, rod or close-to-ceiling suspension. Loops for chain hanging.

Wheeler REFLECTOR COMPANY

Lighting Equipment Specialists Since 1881



UNIVERSAL GRINDER, mounted on a portable stand and equipped with a flexible arm, finds many uses in this motor repair shop. Many hand chores have been eliminated by this grinder built from scrap parts.

brush on the mandrel and he can remove varnish from stator laminations in a jiffy; or use a grinding wheel to cut down high spots on the core or smooth over a welded seam. If there is any polishing to be done, a buffer can be attached to the mandrel. In addition, the boys find 101 other uses for this handy machine around the shop.

ARMATURE STRIPPING

Suggestions submitted by the man on the job through the Improvement Record System of Carnegie-Illinois Steel Corp. has reduced d.c. armature stripping time 75 percent.

Special tools have been forged and ground to correct specifications to accommodate every armature in the mill. The shank of all the tools are standard and fit into the chucks of small air hammers. Two types of tools are used—one for removing commutator leads and one for extricating coils from slots.



COIL LEADS are driven out of commutator riser slots with an air hammer and specially forged and ground tools.

Many sizes and shapes of each type are available to cover all the various rotor and riser slot dimensions of the many different armatures.

The armature is suspended on V-blocks with bearings in place on the shaft so that it can be easily rotated to facilitate and speed the stripping. After banding wire has been removed by a special wedge tool and air hammer, the correct tool is selected for the commutator riser. A few "shots" from the air hammer quickly drives the lead out of each slot.

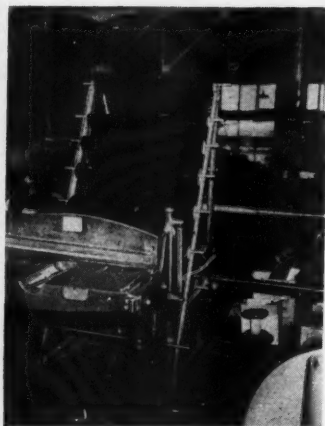
After all commutator leads have been



THE COIL itself is jacked out of the rotor slot in much the same manner. A few quick shots and the coil is out.

driven out, the correct tool is selected for the size of the rotor slot and the coils are driven out in much the same manner.

Average stripping time per armature has been reduced to approximately 25 percent of that required under the original method of extracting coils and leads with a hand peen-hammer.



WITHIN REACH of the cutting shears, this angle iron frame supports eight rolls of insulating cloth and paper. Being mounted directly behind the shears, this rack permits the operator to unroll any one of the eight rolls and feed it directly to the cutting blade. The Mielke Electric Works, Inc., Duluth, Minn., designers of the rack, finds that it reduces material waste and lost time in this department of their repair shop.



To All Users of Motor Control:

HOW TO BUY FOR TODAY and be READY FOR TOMORROW

The motor control you buy today can be a wise investment that will better prepare your plant for peacetime reconversion . . . simply insist on **UNITROL**, the unitized and interchangeable control equipment that can be "converted" at will!

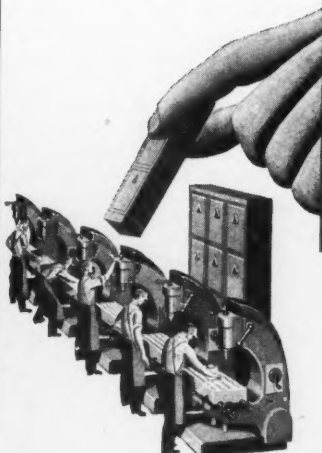
Here's why **UNITROL** is a sensible buy today. It lets you get 2 to 3 times as much control into the same space, lets you arrange your plant's motor control to conform to individual needs, lets you take advantage of "odds and ends" of space and meet your particular manpower requirements. It installs fast, needing only to be electrically connected.

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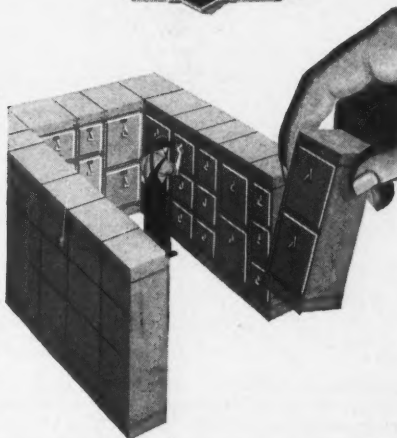
Before you buy any motor control now, send for the 36-page **UNITROL** book. It's free. Write today. **CUTLER-HAMMER, Inc.**, 1306 St. Paul Avenue, Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.



Multiple control can be housed in a **UNITROL** Section alongside the machine it serves.



Control for a machine group or department can be centralized in nearby unused space.



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MODERN LIGHTING

LIGHTING FOR MILLING MACHINES, SHAPERS AND PLANERS

This, the third short article in a series on lighting recommendations for war plant machine tools developed in co-operation with the local WPB office by the Chicago Lighting Institute, will discuss suggested types of light for milling machine, shaper and planer operation. The recommendations outlined below were developed, by a committee of prominent lighting engineers, after a thorough study of lighting systems in several manufacturing plants in the Chicago area, and presented by R. E. Lagerstrom, Lighting Engineer, G. E. Co., Lamp Dept., Chicago.

The machines considered here differ from those discussed in the first two articles in that the tool now is in motion at a high speed compared with the motion of the work. The seeing task differs also since the only indication the operator has of a damaged tool is the marks or scratches that may appear on the work. With the tool spinning at a high speed it is almost impossible to detect the condition of the tool by direct vision. Also, with milling machines in particular, the seeing task may be on any one or several of the six sides of a cube—necessitating a lighting system that will illuminate any or all of these six surfaces.

Usually the work is set up on a jig

and once all adjustments have been made the operation is largely automatic. In setting up the work there are usually very fine details that must be seen. In many instances it will be impossible to provide sufficient and proper lighting with the general illumination system. This means that a local lighting unit must be provided for the use of the setup man and the operator to provide the proper quantity and quality of light in the right direction.

Vertical Milling Machines are usually used on metal castings held in position in a jig or fixture on the bed. The work done by the vertical spindle is usually in the nature of side cuts, top cuts, end cuts or under cuts.

It is almost impossible to set up a vertical milling machine without the use of local light units. Both the machine and the work are of such nature that they cooperate to effectively screen the point of vision from any direct illumination. In one shop visited, where work of this nature was being performed, the RLM fluorescent general lighting system provided approximately 35 foot-candles of illumination—yet there were only four foot-candles at the cut. The addition of local lighting units was the solution.

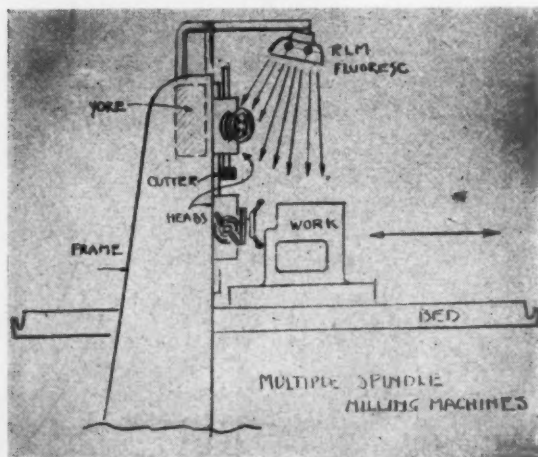
When you consider that some complicated castings may have more than 100 manhours of work expended on them up to this operation, spoilage due

to inadequate and improper lighting is a costly proposition.

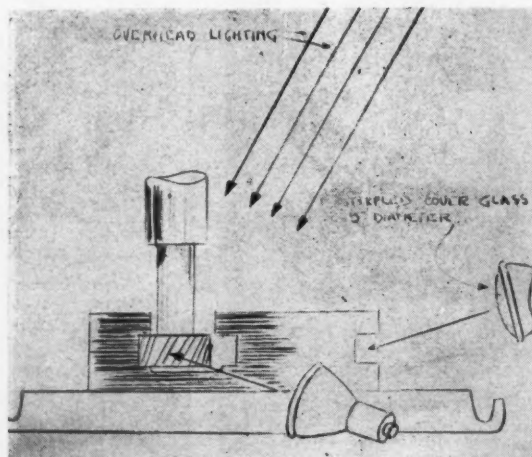
Horizontal Milling Machines perform a multitude of different operations ranging from simple flat milling to cutting very complex castings. In many of these operations there is an overarm which supports the far end of the spindle holding the cutting tool. The position of the machine with respect to the general lighting units must be carefully watched to prevent the overarm from casting a shadow at critical seeing points. Also, local lighting units must be of the proper type and size and carefully located and adjusted to prevent interference with the vision of the operator of that particular machine and those of adjacent machines.

Local lighting units on both sides of the overarm are suggested to facilitate setup work and eliminate the necessity of continually moving the unit from one side of the machine to the other. In many operations such an installation would enable the operator to see the work from both ends of the work table. Where the overarm is pushed back and not used, the setup work is generally of such nature that it can be done without the use of a local light.

However, good general illumination is required even in such cases and should preferably be of fluorescent type or a diffusing unit where filament lamps are used. Bare filament lamps in standard



MULTIPLE SPINDLE MILLING machines can best be illuminated by an RLM fluorescent local light mounted to the yoke of the machine, 12 inches in front. The unit is tilted slightly inward to provide illumination on the dials as well as the cutting tools.

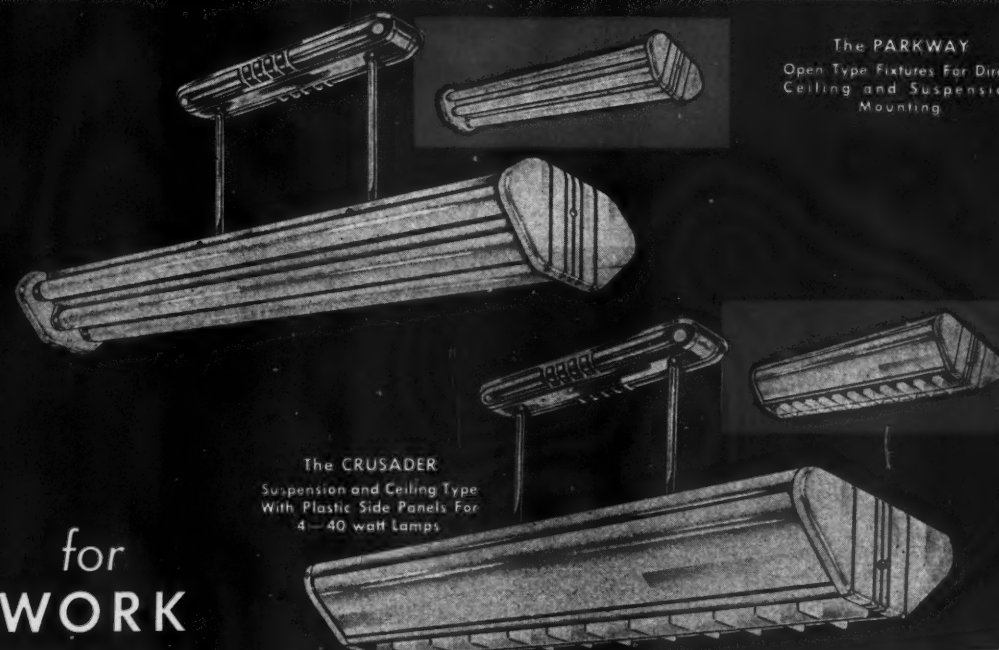


SUPPLEMENTARY LIGHTING directed at the cutting tool and work facilitates setup and operation of this vertical milling machine. The diffused incandescent local lights augment the overhead general lighting system.

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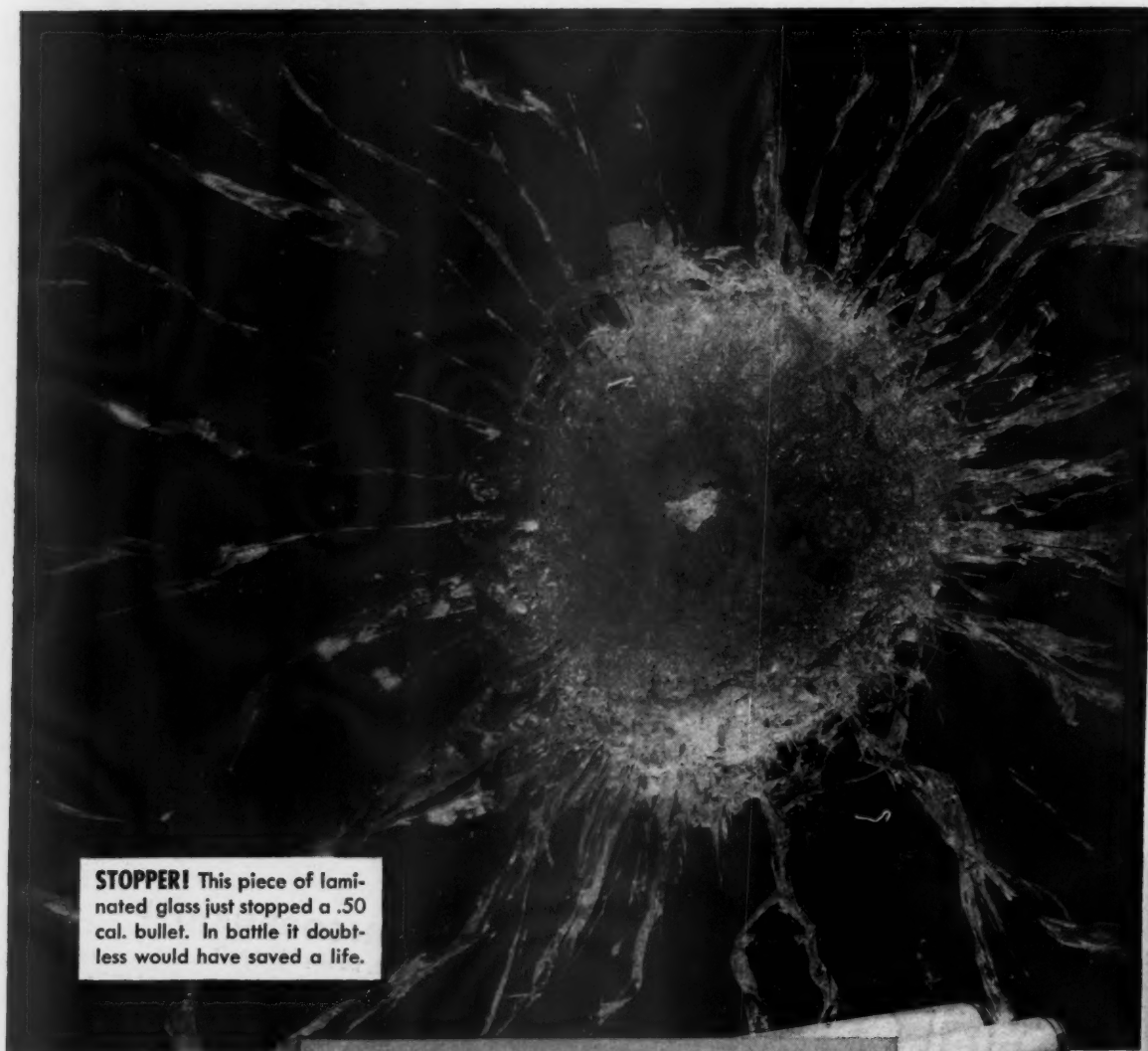


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who man the flying guns

They deserve the best, and they're getting it, these brave young lads who fight it out, high in the sky. Today, in plants equipped for perfect "See-ability," Industry is building amazing new gun turrets for them!



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Permaflexors

Please rush complete data on small-wattage PERMAFLECTOR Floodlight ST-200 - EC 12-48

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RLM reflectors produce sharp shadows and reflections of extremely high brightness which are annoying and make seeing difficult. Also of importance is the favorable arrangement of the lighting units with respect to the work.

Where fluorescent lighting is used, the rows of units should be installed diagonally with respect to the bed of the machine. Where this is impractical, a grid system of general illumination with alternate units mounted at right angles to each other provides a satisfactory substitute. Illumination intensities, considering wartime restrictions, should be in the order of 30 foot-candles.

On horizontal multiple spindle milling machines, where extremely large castings are being milled, the lighting problem is more complicated. Since heavy castings are handled by cranes, the general room illumination is usually at a great distance from the work. The heavy yoke holding the spindles is also a possible source of shadow. Both the setup man and the operator must have good light to see the fine details of the work. The suggested lighting solution for such operations is the installation of a regular two-lamp, fluorescent, RLM unit mounted about 12 inches in front of the yoke and supported by extension brackets fastened to the yoke (see illustration).

Shapers and Planers have essentially the same seeing tasks as the machines previously discussed. Here the tool is usually moving slowly enough so the operator can watch it and take the necessary precautions against damage to it or the work. Setting up the work is usually the most important function and presents the severest seeing problem.

One of the operations studied by the committee was that performed on torpedo tail cones by a double headed hydraulic shaper. Since there were four settings for each piece and the steel was so tough that tools had to be replaced frequently, the machine had to be adjusted at short intervals. The operation was in the open and clearly exposed to a general illumination of 35 foot-candles from a continuous row fluorescent installation. Seeing tasks on the horizontal could be easily performed, but the illumination on the vertical face of the work was only about 10 foot-candles. Consequently the seeing task here was much more difficult.

Good lighting for such operations can be provided by installing a U-shaped arrangement of RLM fluorescent units around the machine. The fixtures simulate a large area local lighting unit mounted to direct light toward a number of different surfaces. Good general illumination of approximately 30 foot-candles from sources described above will provide satisfactory seeing conditions during operation.

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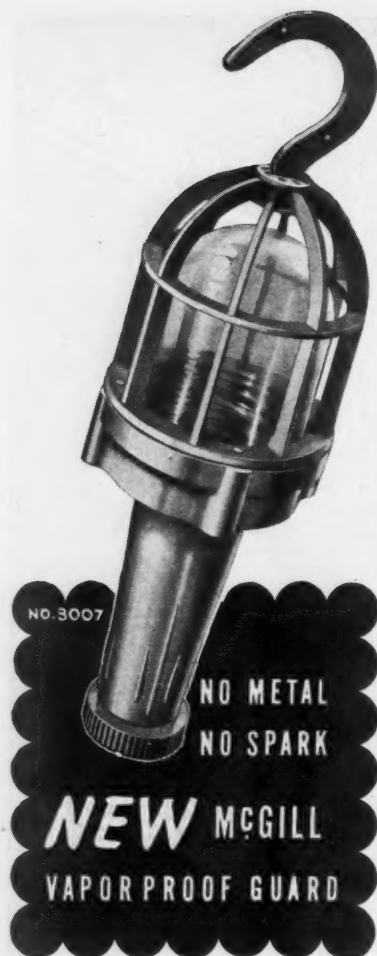
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A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.



This new MCGILL portable safety guard allows you to take the light where it is needed. It is watertight, vaportight and moisture-proof. The plastic handle, and fibre case are shock-proof, non-sparking, and entirely free from metal. No splashing of liquids can harm this guard or cause breakage of light bulb.

The extra strong fibre swivel hook allows you to hang it where you will. Its attractive handle is of unbreakable plastic, with a plastic screw nut tightening on a rubber bushing inside the handle. Its strong fibre cage is treated to prevent warpage. We recommend it for safety, service and convenience, around flour mills, airports, shipyards, aboard ships, warehouses, food processing plants, paint booths and finishing rooms.

MCGILL
MANUFACTURING CO., INC.

Electrical Division
VALPARAISO, INDIANA

Universal Grinders have a lighting problem identical with that of horizontal milling machines. If anything, the operation problem is more severe because the operator must watch the surface of the work at all times. The seeing problem here is similar to that encountered in the printing industry where shining type must be seen against various backgrounds.

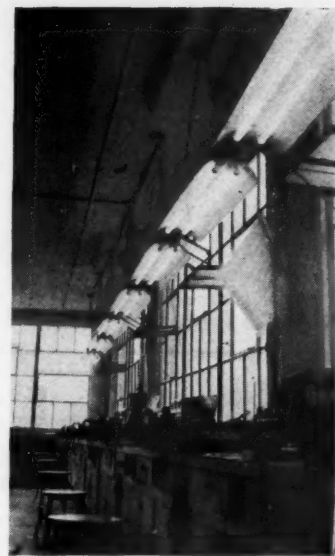
In this case the large area light source would probably have dimensions in feet rather than inches, depending upon the size of the work handled.

FLUORESCENTS INCREASE PRODUCTION

"A conservative estimate would be that our production has increased 20 percent as a direct result of higher lighting levels." This statement was made by J. R. Carpenter, Production Engineer for the Insuline Corporation of America in New York City, manufacturers of radio parts.

The new installation consists of two 40-watt tubes 3500° white fluorescent fixtures mounted at a height of eight feet above the floor or four and a half feet above the working level. Center spacing is 6 feet by 6 feet since assembly benches are spaced six feet apart. Benches are 12 feet long with two or three assemblers working at each bench. The fixtures are arranged longitudinally, two to a bench. A new white paint job on ceiling, walls and posts adds materially to the increase in foot-candles.

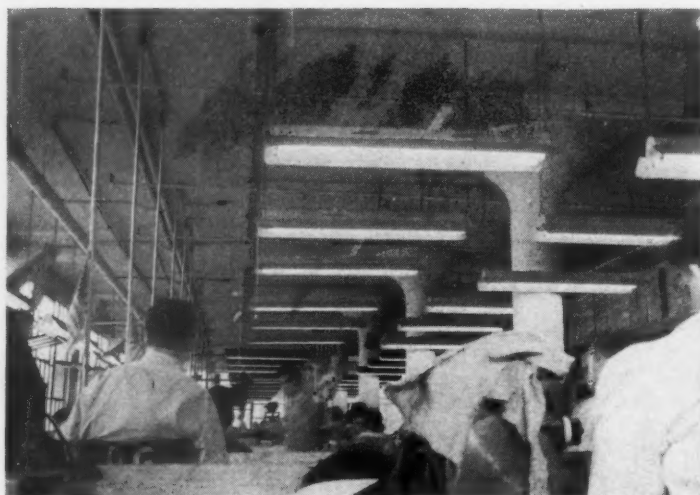
In handling the tiny parts, correct illumination is essential. Originally, fluorescent light was used in the old building but not to the extent of this



GENERAL ILLUMINATION is provided by fluorescents over the die-makers benches and goose neck lamps give the localized light required for the close work entailed in die-making.

installation at their new location. the time of moving it was decided perhaps production output could be raised if illumination levels were increased. Consequently more wattage per square foot was incorporated in the layout and the results have been even better than anticipated.

In the die-making department the same type fixtures have been installed four feet above the bench tops to give plentiful general illumination. In addition, localized lighting from 100-watt goose neck lamps provide ample foot candles for the close work entailed in die-making.



ASSEMBLY AREAS are provided with illumination from fixtures mounted on 6 feet by 6 feet centers, eight feet above the floor. Two tube 3500 degree white 40-watt fixtures are used.

Again...

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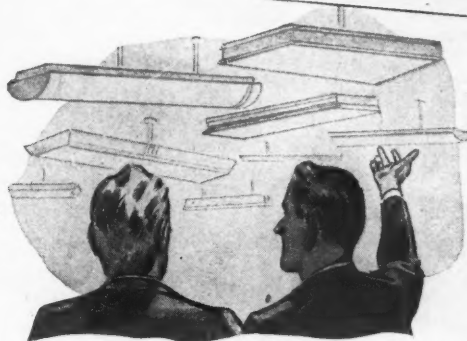
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(as authorized by WPB
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AFTER December 1st, 1943, "commercial" fluorescent lighting fixtures bearing the famous FLEUR-O-LIER Certification Label will again be manufactured and made available for "essential" uses. Fixtures of this type are particularly suited to such locations as factory drafting rooms and offices, hospitals and various public institutions.

Many of the leading fixture makers participating in the FLEUR-O-LIER program will manufacture these units, which gives you a wider variety of sizes and designs. These new FLEUR-O-LIERS will combine the best features of pre-war equipment, plus improvements developed to help

the war effort. And all will conform to WPB Limitation orders in the use of critical materials.

You can depend on these units, because like all fixtures labelled FLEUR-O-LIER, they are CHECKED and CERTIFIED by impartial experts—Electrical Testing Laboratories, Inc., of New York. They all meet rigid FLEUR-O-LIER specifications for Electrical, Mechanical and Lighting Excellence.

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Electrical Contracting, December 1943

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Electronic Motor Drive

Smooth acceleration and close speed regulation at an infinite number of speed settings made possible by the thyatron and electronic control.

THE electronic art is making rapid advances in the industrial field. A direct current source of power is no longer required to feed the small d.c. motors used for various types of drives. The thyatron tube now takes a.c. power from the ordinary plant distribution system and converts it to direct current for the d.c. driving motors. Special designs for special applications were made as far back as 1928, but now units are available from a standard line for standard application. This newly developed electronic drive is sold under the trade names of Thy-Mo-Trol by General Electric and Mot-O-Trol by Westinghouse.

Among the many features and advantages of this electronic drive is the smooth acceleration accomplished by a constant current-limit scheme employed during the starting period. Also close speed regulation can be obtained at any one of an infinite number of speed settings, automatically, by supplementary electronic control.

This new motor drive was not developed with the idea that it can or will supplant the various other types of mechanical and electrical drives in use today, where such drives have the necessary characteristics and provide all the features required. The development has been carried on rather to evolve an electronic drive providing features not inherent in conventional drives where close speed regulation and smooth acceleration over a wide range of speeds, and certain other features are desirable.

The standard line of electronic motor drive is available for controlling d.c. motors up to one and two horsepower.

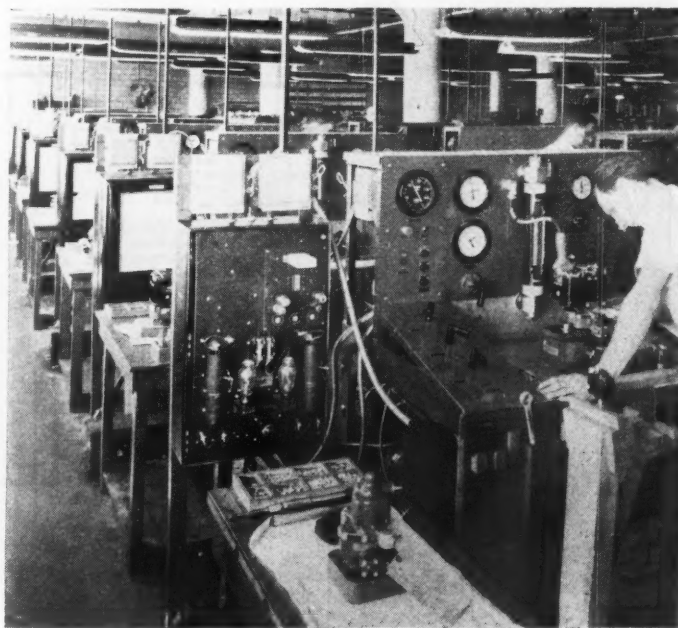
Full-wave rectification of single phase power is used to supply both field and armature current. For motors of larger horsepower rating, a two phase full-wave or three phase half-wave rectifier may be used depending upon the most economical application of tubes.

Four separate mountable pieces of equipment are involved—the small anode transformer, the rectifier panel and control cabinet, the control station and the d.c. motor.

The anode transformer is used in

order to make use of standard voltage motors. By designing a special motor it would be possible to eliminate this transformer but it is felt that use of standard design motors have a definite advantage to the user. The transformer is either auto or insulating type of conventional design.

The rectifier panel contains the control and power tubes, line contactor, thermal overload and field-failure relays, cathode-protective timer, anode fuses, and the necessary control trans-



ELECTRONIC MOTOR DRIVE facilitates and speeds the testing of airplane propeller governors. The d.c. driving motor operates over a range of 900 to 3000 r.p.m. Electronic control holds each specific testing speed within very close limits as the load is varied over a wide range.

formers, capacitors, reactors and resistors for the electronic circuits. The front of the panel, which carries all the tubes and the adjusting potentiometer dials, is hinged and can be swung completely open so that wiring and circuit accessories are readily accessible.

The control station is a standard heavy-duty pushbutton station with "Forward", "Reverse" and "Stop" push-buttons, a forward potentiometer and a reverse potentiometer. Each speed control potentiometer is a type which covers the entire range of armature and field adjustment on a single dial. Approximately half of the contact circumference adjusts the speed from zero to base speed by armature voltage control with full field; the other half adjusts from base speed up to top speed by field weakening. Adjustments may be made at any time while the motor is running. Different forward and reverse speeds may be preset so that only operation of the pushbuttons is necessary to obtain a predetermined speed in either direction.

The motor is a shunt wound d.c. machine and usually rated 230 volts in order to make most economical use of

the rectifier tubes. Although a conventional type motor is used, its characteristics must be such that it will operate satisfactorily from an unfiltered rectifier supply.

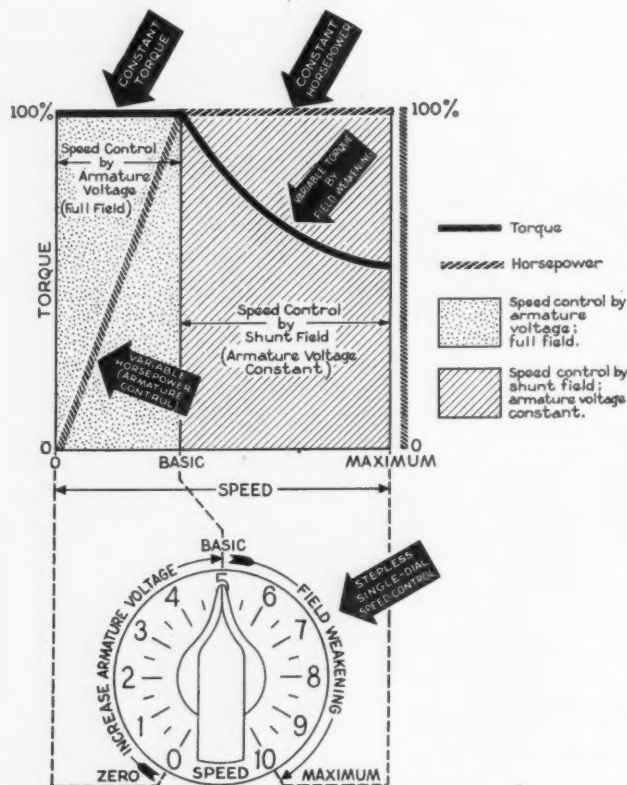
Characteristics

Starting a load with minimum shock and under conditions permitting satisfactory commutation is an ideal characteristic of good drive. This newly developed electronic drive employs an accelerating scheme which does approach this ideal—constant current-limit acceleration. An adjustment in the panel allows the operator to vary the accelerating torque to a value which will bring the motor up to operating speed in the quickest time consistent with the nature of the load and the commutating ability of the motor. From the moment the start button is pressed, the motor receives exactly and continuously the preset value of current. Thus the motor pulls up to its preset speed with a smooth, uniform torque; and then the current drops back to the value needed to maintain the load torque.

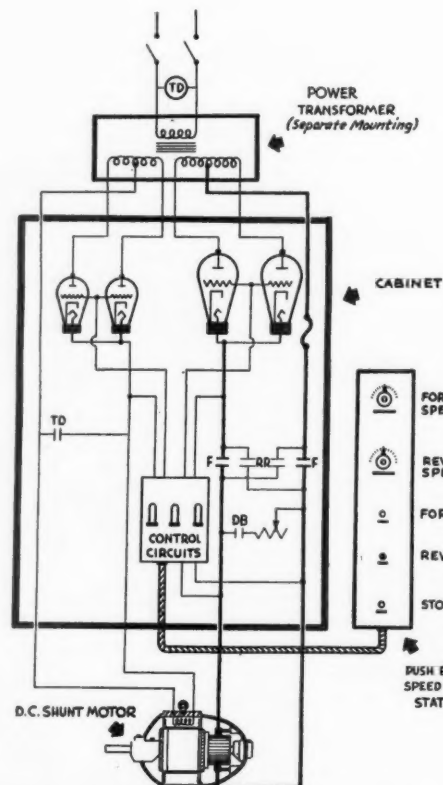
The motor is always started under full-field conditions regardless of whether the potentiometer has been preset to operate the motor in the armature control range below base speed or in the field weakening range.

Protection is provided against sustained overload by a conventional thermal overload relay; against short circuits by suitable anode fuses; and against runaway by a field-failure relay.

Quick stopping of the motor is provided by conventional dynamic braking when the stop button is pressed, power is disconnected and a resistor is connected across the armature. Standard equipment does not provide for a regeneration or pump-back, so that when the speed adjusting potentiometer is quickly turned from a high to a low setting, the motor merely coasts down to the new setting at a rate determined largely by the friction or counter-torque of the load. During sudden speed reduction periods with a full-field, excessively high voltages may be generated, but means are provided to keep the voltage down to safe values. Where quick slow-down is required a modification can be provided to give a form of dynamic braking



A SINGLE DIAL CONTROLS the entire speed range. Note the relation of horsepower and torque throughout the base and field-weakening speed range.



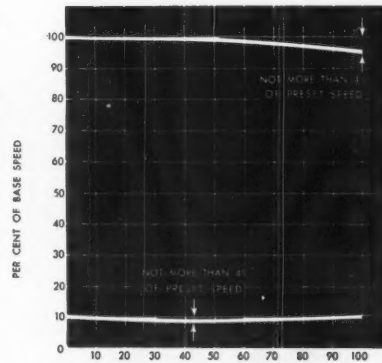
THIS SIMPLIFIED DIAGRAM shows the function of the various circuit elements. The two smaller thyristors supply the shunt field and the larger ones supply the armature.

GUIDE SHEET

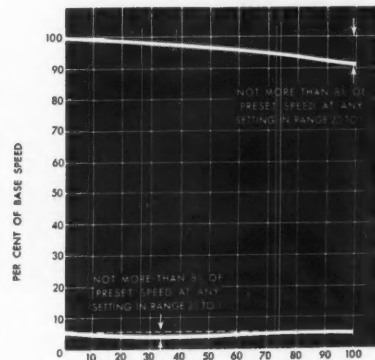
TYPICAL INDUSTRIAL APPLICATION OF ELECTRONIC MOTOR DRIVE

Industry	Application	Operating Requirements
Aviation	General purpose testing, machinery, such as for fuel pumps.	Wide speed range; stepless acceleration.
Cement	Conveyors.	Constant speed for any speed setting.
Ceramic	Lathe drives.	Adjustable speed.
Chemical	Feeders (conveyors or pumps).	Adjustable speed; close speed regulation at any speed setting.
Food	Bottling and packaging machines.	Medium speed range; close adjustment.
Laundry	Flatwork ironers.	Adjustable speed; constant torque; non-reversing.
Machine Tools	For all machine tool feeds, such as on lathes, grinders, and milling machines. Slotters, key seaters and gear cutting machines.	Wide speed range; good speed regulation; reversing dynamic braking. Adjustable speed; good regulation.
Glass	Glass drawing.	Wide speed; close speed regulation.
Materials Handling (all industries)	Feeder conveyors, assembly conveyors.	Adjustable speed; high starting torque.
Steel Mill	Straightening machines. Spinning or flanging machine feed. Cold or hot saw feed.	Adjustable speed; frequent starting; dynamic braking. Adjustable speed; high torque at low speeds; dynamic braking. Adjustable speed; good regulation at any speed setting.
Mining	Ore concentrators.	Constant speed for any speed setting.
Paper	Wire shakes and rotating filters. Rotary cutters, slitters, winders and single intake shaft drive on combining, waxing or paper-treating machines. Reels.	Medium speed range; uniform speed. Low threading speed; medium speed range; close regulation at any speed setting; smooth, stepless acceleration. Accurate speed setting; wide speed range.
Paper Converting	Top roll drive and dandy roll drive. Bag machines, folders, inter-folders, creasing, perforating and embossing machinery. Laminating and coating machines.	Medium speed range; close regulation. Low threading speed; constant speed at any speed setting; stepless smooth acceleration. Wide speed range; stepless acceleration.
Power Generation, Heating and Ventilating	Coal feeders.	Adjustable speed; constant torque; good regulation.
	Stokers.	Wide range of speed; close regulation.
Printing	Small web-fed rotary printing presses.	Inching; dynamic braking; close regulation at any speed setting; smooth acceleration.
Rubber	Small tubing machines.	Adjustable speed; good regulation.
Textile	Warpers and winding reels.	Constant linear speed at any given setting (constant tension).
	Starch mangles, paddlers, and sanforizers.	Wide speed range; close regulation.
Woodworking	Lathe feed.	Wide speed gauge; constant torque.

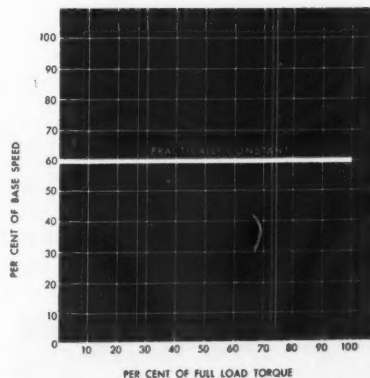
TYPICAL SPEED TORQUE CURVES



20 to 1 SPEED RANGE has maximum speed regulation of within 8 percent for both low and high speeds.



10 to 1 SPEED RANGE limits regulation to 4 percent at either low or high speeds.



CONSTANT SPEED, from zero to maximum torque, is obtained at any speed within the operating range.

FUSIBLE plugs and receptacles

Type FP 2-pole
fusible plug



Type LRA
receptacle with
threaded housing

built for heavy duty service

General Purpose plugs and receptacles are heavy duty types with round prong contacts mounted in molded insulation and with cast metal housings of rugged construction to withstand hard use. The complete range of types includes fusible plugs, cable connector plugs and receptacles, and receptacles in many housing types with conduit fitting bodies in standard styles and sizes. Fusible plugs on extension circuits will isolate a defective device without interruption to other equipment. General Purpose plugs and receptacles are available in 1, 2, 3, 4, and 5 poles, ratings 30, 60, 100, 200 amperes. Write for Pylet Catalog with complete listings of all types.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

to slow the motor from one speed to another.

The speed range obtainable with this type of equipment is (theoretically) something from a value approaching zero to the maximum for which the motor is designed. Practical limits, however, are largely determined by the heating and stability of the motor. Tests show that the motors may be operated over a range up to 20 to 1 below base speed by armature control on an intermittent basis without approaching a dangerous temperature rise; and above base speed as high (generally 2 to 1) as the mechanical limitations of the motor permit.

Speed Regulation

By providing closely regulated armature voltage with automatic compensation for IR drop, motor speed is held constant within very close limits (at any preset speed up to the base speed) independent of load and ordinary line voltage variations. An adjustment is provided in the panel to allow a drooping speed regulation characteristic where desirable.

When the motor is operating at any preset speed in the armature control range (below base speed) regulation can be held to approximately a 20 percent variation from no load to full load. When operating in the field-weakening range, the speed will decrease with load to a value not exceeding 10 percent.

Where speed regulation on the order of plus or minus $\frac{1}{2}$ percent is desired it may be obtained by use of the output voltage of a tachometer generator that is directly connected to the motor shaft.

Supply voltage variations of as much as 10 percent will only slightly affect operation, but to obtain maximum tube life the variation should not exceed plus or minus five percent.

In the event of tube failure, circuits have been so designed as to render them entirely safe regardless of which tube or combination of tubes fail.

Principle of Operation

From the accompanying diagram it is seen that single phase alternating current is supplied to the small anode transformer. The secondary circuit of the power transformer can be traced through the plates (or anodes) of a pair of thyratrons, through the cathodes to the field of the motor and back to the transformer winding. The other secondary can be traced similarly through the armature of the motor. Each pair of tubes constitutes a full wave

rectifier supplying a pulsating d.c. voltage to the motor. By varying this pulsating output voltage of the thyratrons the speed of the motor is likewise affected.

Phase displacement is the vehicle used in output voltage control. By use of a resistance-reactance bridge, the phase of the thyatron grid voltage may be varied with respect to the anode voltage, from completely in phase to 180 degrees out of phase. This is done by varying one of the elements of the bridge circuit which in this case is a saturable-core reactor. When the two are completely in phase, the tube will be full "on" supplying maximum voltage to the motor. When the two are entirely out of phase the tube will be completely "off" supplying no voltage to the motor. Thus, between these two limits, any desired voltage may be automatically maintained.

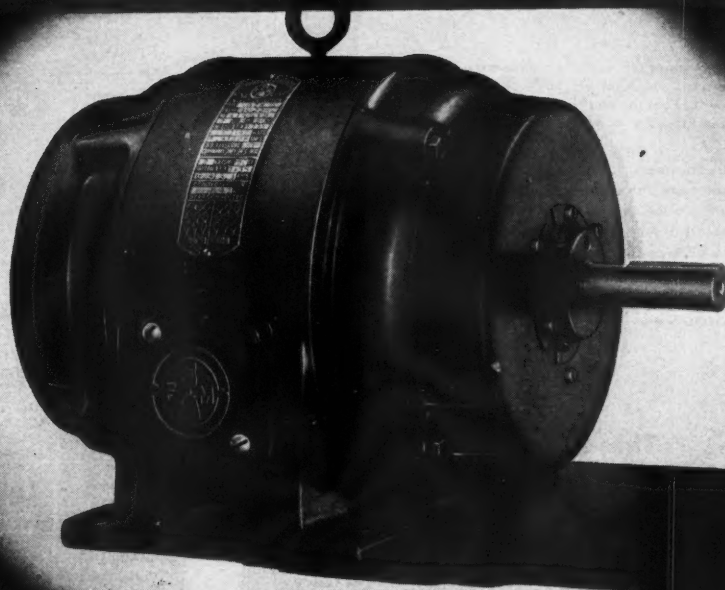
Starting from a zero speed with full-field, any motor speed can be obtained up to the base speed by varying the armature voltage from zero to maximum. Further speed increase may be obtained (normally a 2:1 range) by weakening the field through reducing thyatron output voltage by grid control.

A scheme known as electrical feedback is used to automatically control each of these output voltages separately. A group of radio-type control tubes act as amplifiers of current and voltage signals received from the motor. These tubes then supply the necessary direct current to the saturating winding of the saturable-core reactor in the resistance-reactance bridge which is used to vary the output voltage by the phase-displacement method just described. The automatic varying of this d.c. current in the saturating winding is responsible for the extremely close speed regulation obtained for any preset speed over the entire range regardless of load.

The constant current-limit acceleration of the motor is similarly accomplished by controlling the output of the armature tubes. Instead of a bridge, however, a transformer connected into the anode circuit of the armature tubes and rectified secondary current is the control vehicle.

When the motor is operating at speeds below base, that is, with full-field and reduced armature voltage, it will provide constant torque. Consequently the horsepower will decrease in direct proportion to the decrease in speed. When operating above base speed, that is, with full-armature and reduced-field voltage (weakened field) the motor will provide constant horsepower with consequent reduced torque output.

Never Before - A Motor Like This



WITH

Copperspun ROTOR

Buy War Bonds

You've never seen a motor like this new Fairbanks-Morse Motor, because never before have so much stamina, versatility, and protection been built into one motor housing!

CHECK THESE POINTS . . .

- ✓ **1. 40° C. Motor.** ✓ **2. Protected frame.**
- ✓ **3. Conduit box** has controls that give new meaning to "adaptable," "convenient," and "handy."
- ✓ **4. Famous Fairbanks-Morse COPPERSPUN Rotor**—the *ONLY* rotor centrifugally cast in *ONE* piece and of *COPPER*.

If you are buying motors now but want them to be up-to-date for postwar production, see this motor demonstrated. *There's no other way to appreciate how much more it offers you!* Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

FAIRBANKS - MORSE

DIESEL ENGINES
PUMPS
MOTORS
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Motors



DATA SHEET

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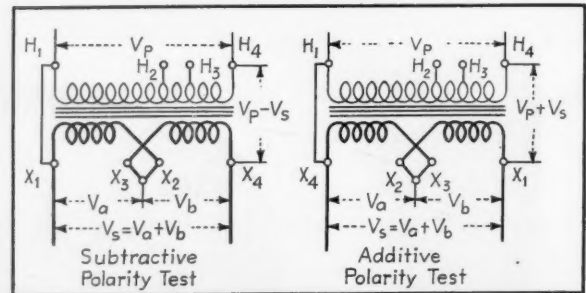
T-1

Transformer Polarity Classifications

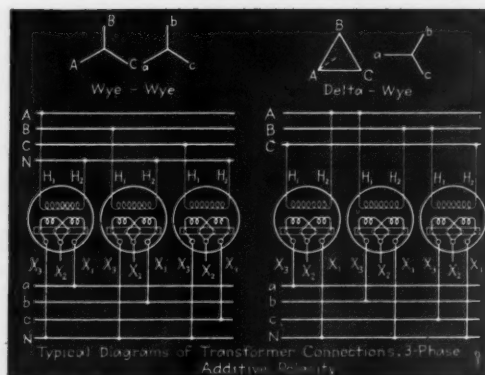
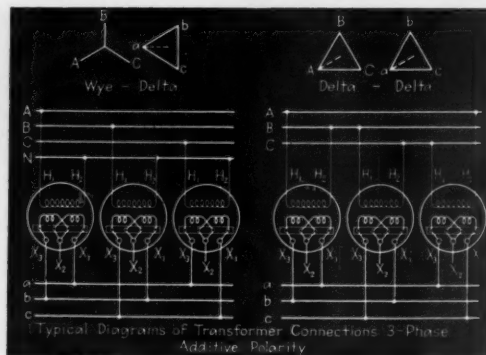
Single Phase Transformers

Leads brought out from the windings of transformers are marked with consecutive numbers so that high and low mark full winding and intermediate numbers mark the taps.

Transformers to be operated in parallel must not have the same voltage ratio and the same impedance value but must be in the same polarity, that is, they should both be of additive or both of subtractive polarity.

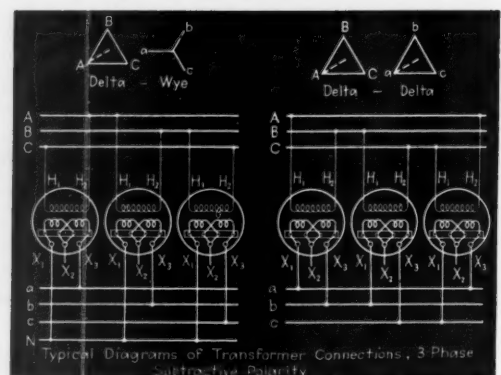


Three Phase Transformers



Three Phase Transformers		
Group 1 Angular Displacement 0°		
Group 2 Angular Displacement 180°		
Group 3 Angular Displacement 30°		

Six Phase Transformers		
Group 4 Angular Displacement 0°		
Group 5 Angular Displacement 30°		

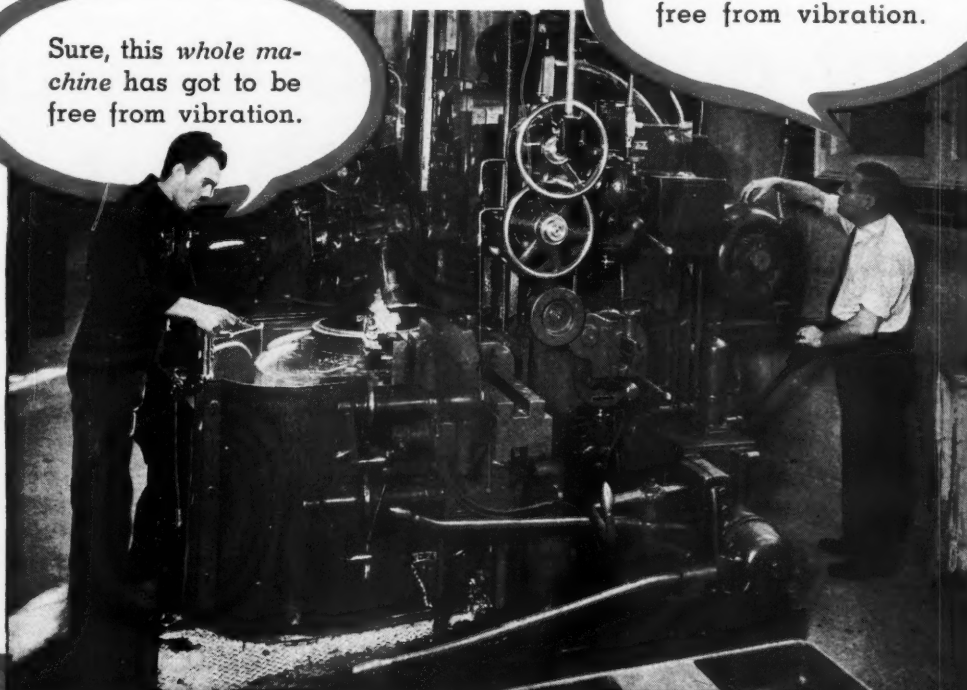


Information obtained from Westinghouse Electric & Mfg. Co.

Take a Look at
TOMORROW—*Today!*

Sure, this *whole machine* has got to be free from vibration.

This Century Motor is certainly unusually free from vibration.



CENTURY MOTORS' Unusual Freedom From Vibration Contributes to More Accurate Machine Tool Performance

The unusual freedom from vibration of Century Motors matches the precision and accuracy of the thousands of machine tools they drive.

Determine for yourself — put your fingertips on a Century Motor and you'll hardly realize it's running — because of its quiet operation and solid feel.

When tolerances must be held to the closest limits, the rotational balance of Century Motors is all-important, including:

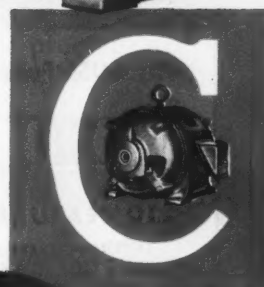
- Magnetic Balance
- Mechanical Balance
- End Bumpers
- Rugged Frames
- Accurately Machined Feet
- Extreme Rigidity

Every contribution to precision workmanship, to increasing the speed of production and decreasing the number of rejected pieces is particularly important today under the demands of War. It is important, too, in peacetime production, as tolerances grow finer and advanced engineering demands extreme precision work.

Today and tomorrow, the unusual freedom from vibration of Century Motors grows increasingly important. It will pay you to remember Century for practically all your future motor applications — from fractional to 600 horsepower.

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Offices and Stock Points in Principal Cities



345

... "BUSS Fuses have kept our Cupola Blower Operating without a Needless Shutdown ... formerly we had an average of two outages per month,"

Says

ELECTRICAL MAINTENANCE SUPERINTENDENT

KARL MOEHLMAN

of Gisholt Machine Co., Madison, Wisconsin



"From a production standpoint," continues Mr. Moehlman, "probably the most important circuit in our plant is for a 50 horsepower, 220 volt, 3-phase motor operating a cupola blower. This blower simply *must not* fail, otherwise serious production loss occurs, involving damage to critical material.

"This particular circuit was blowing fuses at an average rate of twice a month, until we switched to BUSS Super-Lag fuses more than six months ago. Since the change, not a single fuse has been blown."

Why BUSS Fuses Don't Blow Needlessly



10 FEATURES
in the design of
the FUSE-CASE
help make it possible. . . .



and **The SUPER-LAG**
development in
the FUSE-LINK
completes the job.

BUSS



Can Mr. Moehlman's experience at Gisholt suggest to you a way to eliminate needless production shutdowns due to fuses opening needlessly? His experience is like that of many others who have found that the long time-lag of BUSS Super-Lag fuses prevent needless shutdowns due to harmless overloads. Yet these fuses give you the protection you need when serious trouble occurs.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here is why BUSS fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced

person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

How to solve the "shutdown" problem

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.
Division McGraw Electric Company

Super-Lag FUSES

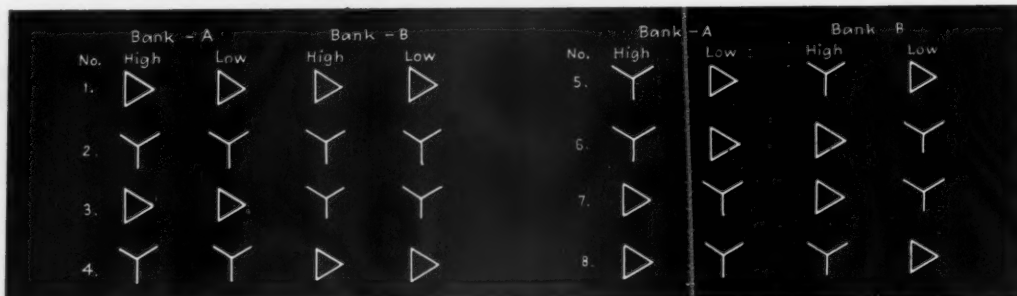
SOLD THROUGH WHOLESALERS

DATA SHEET

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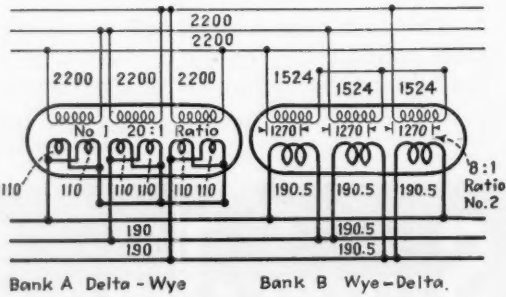
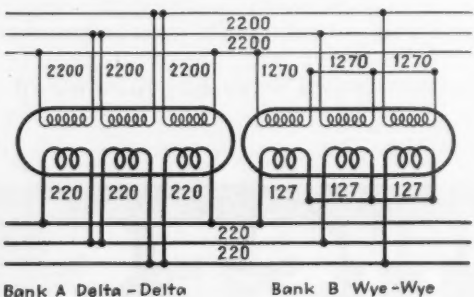
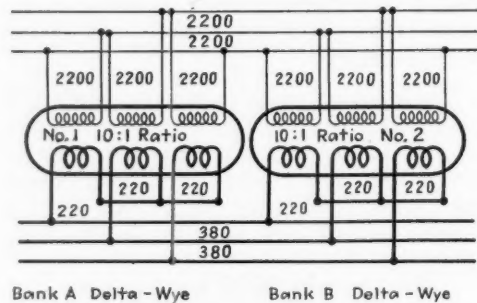
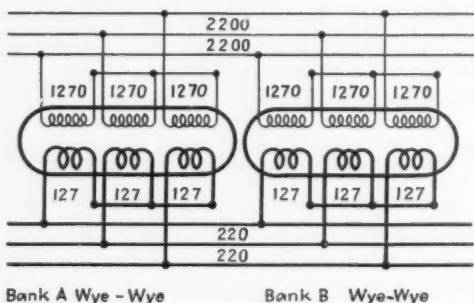
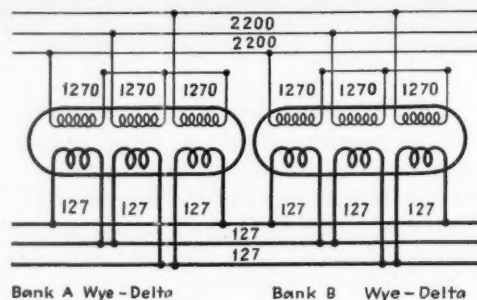
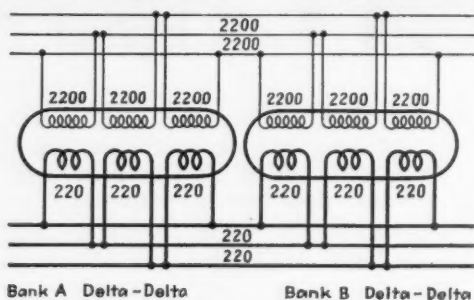
T-2

Paralleling Three Phase Banks Eight Possible Operative Parallel Connections



To parallel three phase banks, voltage ratio, polarity, phase rotation and angular displacement must be the same. Total impedances must be correct to insure

proper sharing of load. External reactance can be connected in series with transformer windings (usually the secondaries) of bank to obtain proper impedance values.



Information obtained from
Westinghouse Electric & Mfg. Co.

Taps and ratio have been changed to permit paralleling. A slight circulating current may result from ratio difference, but the wye connection in each bank will equalize secondary line voltages by an inherent shifting of the neutral.



"...FROM
THE
HORSE'S
MOUTH."

In addition to ultimate limits data, SHORT-TIME RATINGS for overloading are invaluable to us. Most of our equipment is protected with automatic alarm devices. If we know the duration of the overload period of a transformer, our men know how soon they must get to an overloaded transformer in order to avoid breakdown.

If we knew at what point the insulation starts to char, how long it takes for this to happen, we'd be much more able to load up equipment. Every big piece of equipment can withstand high temperature for a certain length of time. It takes some time before the high temperature has saturated the equipment to such a point that a rapid increase in temperature to the breakdown point occurs. We need that information today.

Can the transformer manufacturers tell us what accessories are available on various classes of DISTRIBUTION TRANSFORMERS? For example: are drainage plugs, filter-press connections, oil-sampling devices, oil gauges, thermometers, etc., included as standard equipment on distribution transformers of 50 kva and over or 250 kva and over? There is need for some clarification on this.

The above is an excerpt from the "E-A" Reporter, issued by the publishers of Electrical World.

Send....

for your copy of Wagner Bulletin TU-40, on "Normal and Emergency Loading of Power Transformers". It is a valuable and convenient reference manual. Use coupon at lower right.

When Questions Like These Arise WAGNER Has the Answers

Answers to questions such as asked in the "E-A" Reporter are of vital importance to all transformer users.

Wagner Bulletin TU-40 on "Normal and Emergency Loading of Power Transformers" is a comprehensive treatise on the subject of transformer overload, and Bulletin TU-180 answers the questions of design and construction of distribution transformers, and also includes information on available accessories.

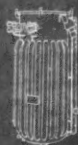
These bulletins have been edited by qualified transformer engineers, and are only a few of the many bulletins that should be in the hands of everyone responsible for the purchase, installation, and maintenance of transformers.

No matter what your transformer requirements may be, or what your transformer problems are, consult the nearest of Wagner's 29 branch offices, located in principal cities and manned by trained field engineers.

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Gentlemen:

Please mail me my copy of Bulletin TU-40 ☐. I would also like to have Bulletin TU-180 on Distribution Transformers ☐, and TU-181 on Power Transformers ☐.

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T43-6

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

READER'S QUIZ

BAD SPOT ON COLLECTOR RING

QUESTION 116. *On our motor generator set a bad spot on one collector ring on the a.c. end has recently appeared. This ring is the inner one next to the armature. I'd like to know what caused it, and why it is only on one ring. It causes plenty of fire works and I expect it to arc over. These rings get their d.c. for excitation from the d.c. end of same machine.—R.G.S.*

A. TO QUESTION 116. I have had a similar experience with wound-rotor type motors although not always the inner collector ring.

The most frequent cause of this trouble was the breakdown of insulation between the collector ring and the shaft causing a ground and sometimes arcing across to the next collector ring.

Other causes of this trouble have been; not sufficient tension on brushes, also brushes being too tight in brushholder and not making proper contact.—T.R.

A. TO QUESTION 116. Arcing may be caused by insufficient brush pressure on the ring. This may be caused by the springs not having enough compression or by the brushes sticking in their holders. Periodic inspection should be made by lifting the brushes to see that they move without excessive friction in their holders and that the brush pressure on the ring measured with a spring balance is normal. As the brushes wear shorter the springs should be adjusted to keep the pressure normal.

Sometimes arcing may be caused by the ring having a hard spot which wears slower than the other softer surface thereby causing the ring to become eccentric. The brushes jump slightly when they come to this higher hard spot and cause the arcing.

This condition can be corrected by grinding the ring with special emery

wheel refinishing equipment until the periphery runs true and readjusting the brushholders and brushes to fit the re-conditioned ring.—A.W.S.

A. TO QUESTION 116. The bad spot on the collector ring might be due to some impurity in the metal. This could cause uneven wear and a rough spot which could cause the brush to jump or "chatter" and result in arcing. Once started the condition would be apt to get worse. The ring should be smoothed and checked to see whether it is true.

A second possible cause of trouble would be a poor connection where the field lead is fastened to the ring. High resistance here could cause heating and warping of the ring.—J.E.W.

A. TO QUESTION 116. The bad spot could have started from any one of several reasons. It should have been removed when it was first discovered as a black spot. In the early stage it is easy to remove with fine sandpaper — if neglected it becomes necessary to grind the ring.

If your machine is shut down for long periods it is quite probable that moisture and/or acid fumes have acted on that part of the ring not covered by the brush and the trouble was from this cause.

Perhaps your rotor has a slight unbalance and causes a jerk in the rings every revolution, indicated by the spot appearing in the same location each time.

The electrolytic action on iron rings sometimes causes this trouble on one ring and oftentimes will entirely disappear if the polarity of the rings is reversed every day or so.

Occasionally ring trouble will arise from unequal hardness of the metal.

If you have not already done so, get at this ring with a stone of proper grade and size and true it up.—E.J.K.

A. TO QUESTION 116. I do not know if I would be sure what

has caused this trouble but have seen this happen before and, of course, it usually happens where there is an electric current flowing through the junction of two dissimilar materials.

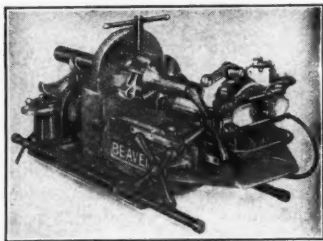
In this case, it is the junction of the brush material and collector ring. Very frequently reversing the polarity on the rings will stop or alleviate the trouble.—M.A.H.

BRAKING A WATER GATE

QUESTION 117. *We have a water gate in a small canal. This gate weighs about ten tons, and slides up and down in a steel structure about thirty feet high. It is powered by a three phase motor through reduction gears with drum and steel cables. The control is pushbutton through contactors with limit switches at upper and lower end of travel. There is no counter balance and the solenoid brake is depended on to hold the gate in the upper position. Once, while under operation, the brake became locked in the open position. The gate rose and tripped the limit switch disconnecting the motor from the line. The brake not holding allowed the gate to fall, causing the motor to travel at such a high speed it tore the winding to shreds. We have our own idea about this problem, but would like to get some one else's idea as to a remedy.—R.M.*

A. TO QUESTION 117. I have a suggestion that would prevent such an accident in the future. R.M. should replace all or part of his present gear reduction with a worm gear reducer. The reducer must be selected with a characteristic known as self-locking in motion, meaning that the low speed shaft cannot drive the high speed shaft even if it is once started by power. If

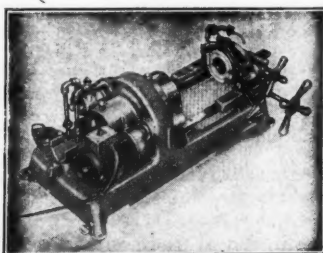
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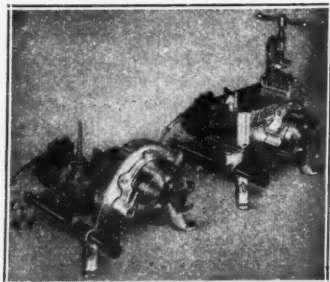
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the gate was being run down full speed and the power cut off the gate would stop. The solenoid brake would not be needed.—C.F.R.

A. TO QUESTION 117. The operation of the gate involves several hazards, particularly so since it is not counterweighted. In view of these hazards, I would use a suitable worm reduction gear unit to drive the cable drum, preferably direct connected to the drum. The motor should have a solenoid operated brake, but should the brake fail, the worm unit would hold the load and prevent further operation in either direction. If possible, I would avoid a magnetic starter with the control buttons. A more positive and safer condition would be obtained by installing a manually operated drum reversing switch and running two of the three phase wires directly through the limit switches. Should the gate then over-travel, the motor would have to stop. The size of the motor and other unknown factors may make such an installation impracticable, in which case I would next consider the magnetic starter with an insulating transformer on the control circuit to entirely isolate the control from the rest of the system. The contactors should be copper and carbon to minimize the possibilities of "freezing" and refusing to open. The insulating transformer on the control would insure the complete demagnetization of the magnetic starter when the limits opened the circuit. Without this, a ground on the system and on the control wiring would hold the starter closed regardless of the operation of the limit switch.

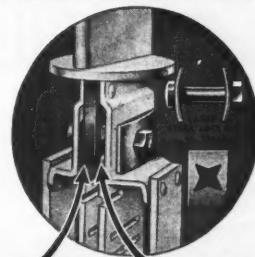
A. TO QUESTION 117. Install an overspeed device on end of motor shaft. This device should have one set of make contacts. Set the device to operate and close the contacts at 5 to 10 percent above normal motor speed. Connect the overspeed contacts in parallel with the pushbutton start contacts on the side that lowers the gate. Then should the brake fail to hold, the motor will run faster than normal, close the overspeed relay contacts, energize the motor again and run the gate to the lower position where the limit switch will stop it normally. The brake can be adjusted or repaired, before operating again without damage to the equipment.—A.W.S.

A. TO QUESTION 117. I would suggest that one of the reduction gears between the motor and the mechanism be a non-reversing worm drive. We have designed a number of heavy door raising mechanisms using a

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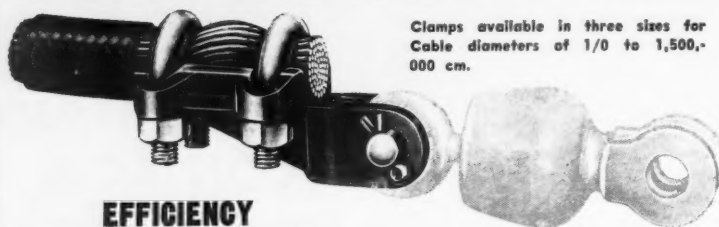


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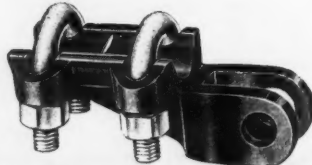
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worm drive, and in the case of R.M.'s job this would have eliminated most of his trouble. In general, solenoid brakes merely reduce the motor WR² so that there is no coasting by the limit switch.—M.A.H.

A. TO QUESTION 117. I would suggest a cylinder and piston installed with the part that exhausts the water or air, whichever is used, adjusted so as to limit the speed of downward travel to a safe speed. A cylinder as used in a sawmill shot-gun feed would do the job. Too, another magnetic brake in parallel with one now in operation should be good insurance, but the cylinder would eliminate need for this.—J. F.

CORRECTION TO QUESTION 113

A typographical error in V.M.'s answer to Question 113 on "Locating Break in Cable" calls for a correction of the formula. It should read:

$$\frac{C_1}{C_2} = \frac{D_1}{D_2} = \frac{x}{2l - x}; x = \frac{2l D_1}{D_1 + D_2}$$

MOTOR REVERSED

QUESTION 118. We have a group of six ½-hp. squirrel cage, induction motors, 220 volts, 60 cycles, 3 phases. All of these motors are connected to the same feeder, but drive different machines. These motors were stopped and when restarted one of the machines was reversed. I made a test of all fuses and all of them were good. What could have caused this one motor to have reversed?—R.E.P.

A. TO QUESTION 118. On first reading this problem it seemed like a trick question. In normal operation a three-phase induction motor rotates in the same direction unless two leads are interchanged. No mention is made of any change in connection, so this explanation seems ruled out.

Further consideration brings up the fact that a single-phase induction motor will run in either direction depending on the starting method. I realize that we are told that all fuses were found good, but with small motors it is possible to have a motor coil burn out without the fuse blowing. If this happened, the motor in question could continue as a single-phase motor (if load is not too great) till stopped.

When restarted, that is, when the switch is closed the motor which is now single-phase will have no inherent starting torque. It can be started in either direction manually or if the burned out coil is shorted it may act as a "shading coil" and so furnish enough torque to start.

Three chances are:

1. Connections reversed.
2. One coil burned out or disconnected and motor started in opposite direction mechanically.
3. One coil burned out and shorted to give the "split phase" or "shading coil" starting effect.—J.E.W.

A. TO QUESTION 118. Since all motors are connected to the same feeders, had the power company changed the phase relation of their lines all motors would have been reversed in direction of rotation. Therefore, the cause of the reversal of one motor must be found in the questioner's plant.

Since the question states that the motors are driving machines, this suggests that a reversing switch might have been used and set at the time in question to run the motor in the opposite direction.

If the motor in question was running a fan in a duct leading to the outside of the building, the cause of the reversal was as follows from my own experience.

There was an open circuit in one line due to a poor contact or broken lead running to the motor causing the motor to be connected single phase.

A current of air coming through the duct from the outside caused the motor to turn in the reverse direction as would naturally happen due to the air pressure against the fan blades.

During this period the motor switch was closed causing the motor to continue to run in the wrong direction.

In my opinion, if the foregoing causes do not apply, the wiring was deliberately changed.—B.A.S.

A. TO QUESTION 118. You failed to state whether you reversed this one motor to acquire the right rotation and that it has been running thus since the day it automatically reversed.

Assuming that you examined the starter or controlling equipment and found everything apparently all right, but upon reversing the leads you found that the motor was still reversed or that the motor would not run at all, your trouble was evidently in the controlling equipment. A loose connection or contacts that occasionally fail to make properly, contribute to the motor starting out and running as a single phase motor in the wrong direction if some action, such as mechanical unbalance of the driven machine, starts the motor in motion.



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This condition often occurs in 3 phase fans, with one side of the line open circuited. The operator starts out the fan with a zip of the propeller and the fan continues to run in the wrong direction. Again, the air currents of another fan blowing upon the propeller of the affected fan may cause this fan to run in the reverse direction if the fan is already running backward because of air currents on the propeller.—D.A.

Can you ANSWER these QUESTIONS

QUESTION S4. We have been having trouble with noisy magnets, particularly on an old automatic three phase, 60 cycle compensator, which is noisy on the running side. Everything seems tight, and the armature seems to line up with the cores of the magnetic coils. Perhaps some one can give some general pointers on the quiet operation of magnets that might help us out.—J.H.G.

QUESTION T4. We occasionally run across 9 lead 3 phase motors that have no numbers on the leads. As these motors are in difficult places I would like to know if there are ways of checking so that we can make our series or parallel connections without pulling motors apart?—H.W.

QUESTION U4. Can you tell me how I can install an electric dynamic braking system on a 200 hp., 440 volt, 3 phase motor, type MR or slip ring motor? What I want is something like what we have on a 100 hp. motor of same type and voltage. When this 100 hp. motor is energized by dynamic brake, we apply 200 amp. at 24 vdc. to one phase of the stator winding and the braking degree is controlled by one, two and three contactors of the secondary circuit. The speed of this 100 hp. motor is 870 r.p.m., 125 amperes, primary 440 volt, 3 phase, secondary volts 274, secondary amperes 160.

The d.c. is supplied by a 208 amp., 24 vdc. generator driven by a 7½ hp. motor.

I want a duplicate hook-up for a 200 hp. motor, Model 85E910G1, Type MR, volts 440, amps. 246, phase 3, cycle 60, speed 870. Secondary volts 532, secondary amps. 171.5.

I can't figure out the volts and current d.c. for the 200 hp., a.c. motor. What will it be?—C.S.M.

QUESTION V4. Could someone suggest a suitable coil spreader and former for a small repair shop and also give details how same could be made up at small cost? Spreader is to take care of motors up to 50 hp. approximately.—W.R.T.

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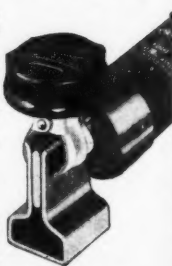
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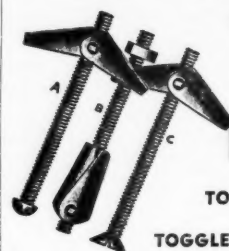
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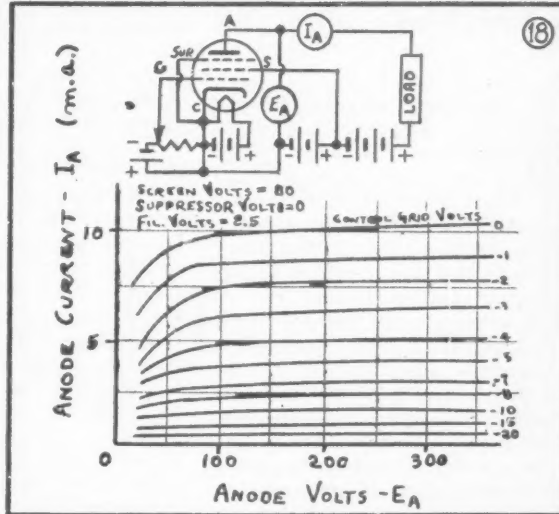
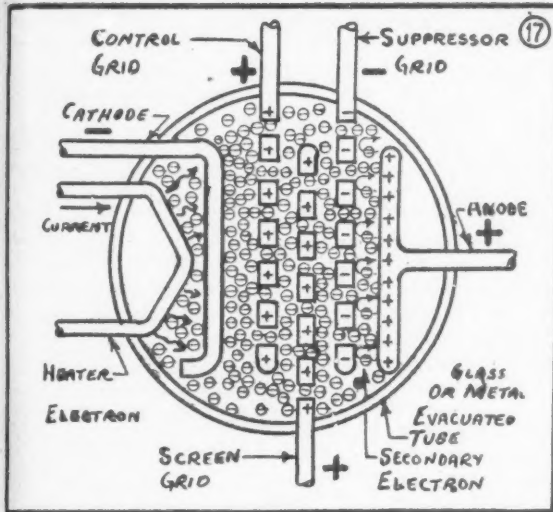
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will attract the electrons and allow current to flow in the external circuit. The negative anode will repel the electrons and prevent current flow in the external circuit connected to that anode.

F. Screen Grid Tube—Vacuum Tetrode

The capacitance between the grid and anode elements is of little consequence when the tube is applied in low frequency circuits. However, when it is operated at high frequencies in the order of several hundred kilocycles, the inter-electrode capacitance between the grid and anode of a triode is detrimental to high fidelity amplification. At high frequencies this capacitance has a very low impedance and will couple the anode and grid circuits together and produce unstable operation. If the tube is used as an amplifier, the output will probably be distorted. The feedback of energy

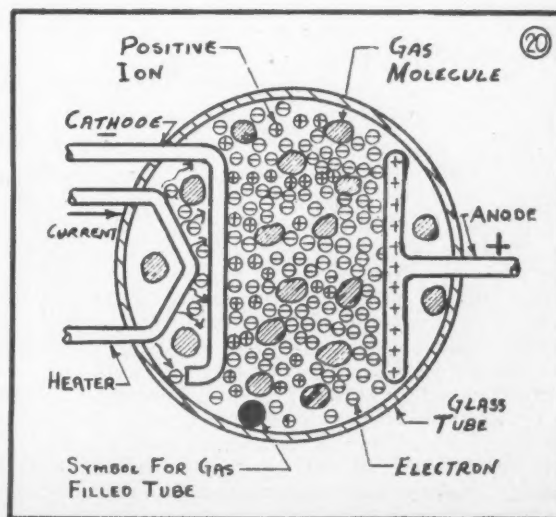
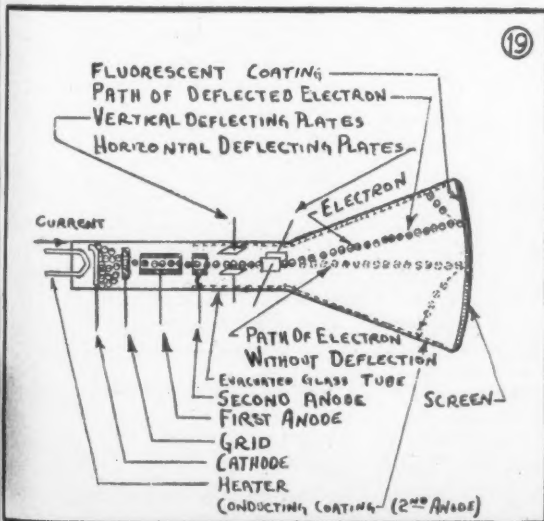
from the anode circuit to the grid circuit may continue until oscillation occurs. When the tube and its circuits oscillate, the tube is of very little value as an amplifier.

The capacitance between the grid and the anode of a triode vacuum tube can be very effectively reduced by the addition of a second grid, called a screen, between them. This tube is called a *tetode* as it has four elements. The screen acts as an electrostatic shield between the grid and anode and reduces the grid-to-anode capacitance. This tube is better than a triode as the anode resistance and amplification factor of the tube are also increased. For typical tetode tubes the grid-to-anode capacitance may be reduced from 16 micromicrofarads for a triode tube to .007 micromicrofarads for a screen grid tube. The anode resistance may also be in-

creased from 1000 ohms for a triode tube to over 1,000,000 ohms for a tetode. A typical tetode tube used as a radio frequency amplifier may have an amplification factor of 780. The screen must be maintained essentially at ground potential as far as the high frequency voltages are concerned, in order to act as an effective screen or shield between the grid and plate.

As shown by Fig. 15, the control grid controls the current flow similar to the action of the grid in a triode tube. The screen grid is usually operated at a positive voltage value but at a value less than the anode voltage. The screen supplies the electrostatic field for attracting electrons from the cathode. As there is a comparatively large space between the screen grid wires, most of the electrons pass through the screen to the anode.

[Continued on page 74]



Fundamentals of Electronic Tubes

[FROM PAGE 73]

The anode current is almost independent of the anode voltage and is predetermined to a degree by the screen voltage.

As the screen is usually operated at a fixed voltage and since the anode voltage may vary, the anode voltage for some circuit applications may at some instant of time be less than the screen voltage. Secondary electrons liberated from the anode by the electrons from the cathode striking the anode will be attracted to the screen as shown by Fig. 15 when the anode voltage is less than the screen potential. The effect of the screen attracting the secondary electrons is to cause a current to flow from the anode to the screen which results in the tube having a "negative resistance" characteristic. In a certain voltage range the total or net anode current decreases with an increase in anode voltage. Fig. 16 shows the negative resistance characteristic for a certain type of tetrode operated in the range of 10 to 75 volts anode potential. In general, a tube of this type should not be operated so that the anode voltage will be less than 90 volts. The tube should not be used as an amplifier if the anode voltage is between 0 to 90 volts. The negative resistance characteristic is sometimes utilized in a Dynatron-oscillator. This type of oscillator is not widely used as other types that are usually more stable and reliable. This tube characteristic has a limited application in trigger circuits.

G. Suppressor Grid Tube—Vacuum Pentode

The undesirable negative resistance characteristic of the tetrode tube may be eliminated by the introduction of a third grid known as a suppressor grid between the screen and the anode. The suppressor grid is usually operated at the same potential as the cathode. As the tube has five elements, it is known as a pentode. The secondary electrons emitted from the anode are repelled by the negatively charged suppressor grid as shown by Fig. 17 and returned to the anode. The suppressor grid provides additional shielding which results in a still higher anode resistance and amplification factor. Pentode tubes used in television amplifiers may have amplification factors as high as 6750. Both the screen and suppressor grids are made of very fine wires which are spaced relatively far apart. This wire size and spacing permits most of the electrons to go between the grid wires in their flight

from the cathode to the anode.

Fig. 18 shows the characteristic curves for a typical pentode tube. From this set of curves it may be seen that the anode voltage can be lower than the screen voltage without seriously affecting the amplification characteristics.

H. Cathode-ray Vacuum Tube

The cathode-ray tube is one of the most useful and important tools available for studying and observing periodic and transient electric wave motions. The electrons in a cathode-ray tube are emitted by thermionic emission from the cathode and focused and accelerated by grids and anodes in the tube. In the tube shown by Fig. 19, the grid controls the density of the electron stream and provides a means for controlling the intensity of the luminous spot or wave shape on the screen. The first and second anodes act as a converging lens and gives the electron beam a sharp focus on the screen. The second anode is usually operated at a high potential with respect to the cathode and this potential will determine the final electron velocity. The enlarged end of the tube is coated with a fluorescent material which will emit light during an electron stream bombardment. The particular fluorescent materials used usually glow with a visible light for a time period depending upon the velocity of impact and concentration of the beam.

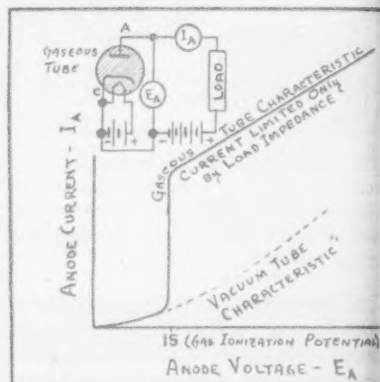
The electron stream may be deflected electrostatically or magnetically. Fig. 19 shows a tube for electrostatic deflection. The electric wave phenomena to be studied may be applied to either or both the vertical and horizontal plates. The electron stream will be deflected proportional to the applied potentials. Electronic sweep circuits may be employed to provide time-amplitude wave forms. A cathode-ray tube for electrostatic deflection control is more sensitive and usually employs a more simple control circuit than magnetic deflection.

2. Comparison of Vacuum and Gaseous Tubes—Thermionic Emission

A very small quantity of gas in a vacuum tube will adversely affect the tube characteristics. The collision between the gas molecules and the electrons which are traveling from the cathode to the positive anode will liberate electrons from the gas and produce positive ions. The positive ions are then attracted to the negative cathode and may bombard it with sufficient force to impair and destroy the emission characteristics of an oxide coated cathode. A chemically active gas may also impair the cathode. The positive ions that are attracted to a negative grid will tend to

decrease its control and considerably alter the voltage-current relationships of a vacuum tube. A tube with a gas pressure of 1/1,000,000 of an atmosphere will produce a luminous glow and the tube will be unsatisfactory for operation as a high-vacuum device.

However, the deliberate introduction of a suitable inert gas such as argon, helium, or neon into a tube at the proper pressure will produce characteristics greatly different from those obtained from the same tube with a high vacuum as a medium between the electrodes. The vapor of some materials such as mercury or caesium are also quite commonly used in gaseous tubes. The



gases previously mentioned are used when the ionization and deionization of a tube must be extremely rapid. The positive ions of these gases are much lighter than the metallic or mercury ions and have a higher transit velocity.

The main differences between a vacuum tube and a gaseous tube may be tabulated as follows:

The high vacuum tube has the characteristics of:

- A large voltage drop from the cathode to the anode.
- A high effective resistance from the cathode to the anode.
- Requires a relatively high anode voltage to obtain a large anode current.
- An energy transfer with a medium efficiency.

The gaseous tube has the characteristics of:

- A small voltage drop from the cathode to the anode.
- A low effective resistance from the cathode to the anode.
- Requires practically no change in anode voltage to obtain a high anode current.
- An energy transfer with high efficiency.

The next article in this series will discuss the controlled gaseous tubes and the mercury tubes which are important to industrial electronic work.



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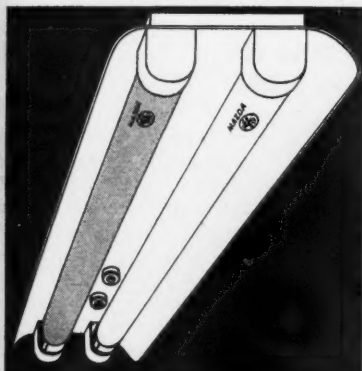
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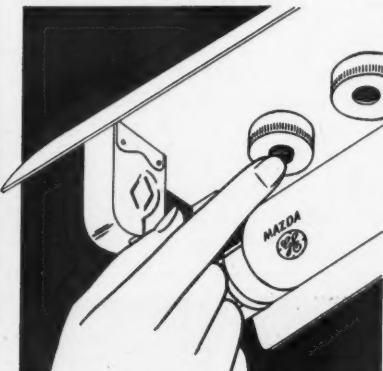
* * *

Distribution and sales of the Watch Dog starters are handled through the Appliance and Merchandise Department. For new Fluorescent Accessories Catalog write to Section GN-1136-F, General Electric Company, Bridgeport, Connecticut.

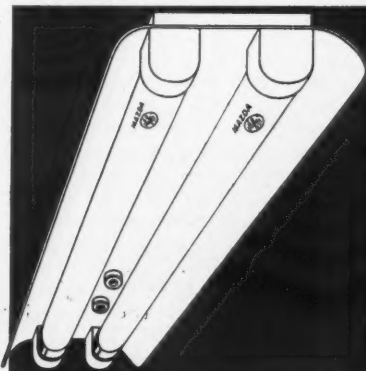
HERE'S HOW NEW "WATCH DOG" STARTERS WORK !



1 When the lamp dies, the G-E Watch Dog cuts out. No flow of current trying to restart dead lamp means no flickering. Current is saved, ballast safeguarded, and starter life prolonged.



2 No "cooling" period is required to reset the starter when replacing a dead lamp. Starter remains in fixture and is reset by pressing button before new lamp is put in.



3 As soon as the new lamp is inserted, the G-E Watch Dog Starter brings it into the circuit immediately, resuming normal lamp operation.

General Electric Lamp Research is responsible for much of the good lighting that is speeding war production today. The never ending goal of that great research organization is to make General Electric lamps stay brighter longer.

**MADE TO
STAY BRIGHTER LONGER**

Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday, 10 p. m. EWT, NBC; "The World Today" news, every weekday, 6:45 p. m. EWT, CBS.

G-E MAZDA LAMPS



Answered by
F. N. M. SQUIRES

Chief Inspector New York Board of Fire Underwriters

QUESTIONS ON THE CODE

QUARTER BENDS

Q. "Because of much discussion I would like to have you explain the part of the Code which says 'The National Electrical Code will not permit the installation of more than the equivalent of four quarter bends between outlets.' I think that a definition of 'quarter bend' would clear up the question right away."—C.F.S.

A. In electric wiring a "quarter bend" is one in which the wire or conduit is bent through an angle of 90°. In some parts an angle of 90° is called a right angle.

The force of Section 3471 of the Code is that conductors are not to be pulled around bends totalling more than 360° (the equivalent of a complete circle) between fittings such as between outlets or between outlet boxes and pull boxes.

In measuring the bend we measure the angle through which the wires are bent. For instance, if the conduit is bent only one-half of a quarter bend, the wires in pulling are bent only 45° and we do not measure the 135° angle (See Figure 1):

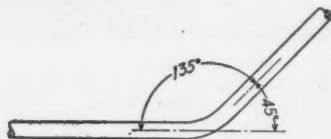


FIGURE 1

If we did attempt to go to the very bad practice of trying to pull the wires through an angle sharper than 90°, we would measure the angle through which the wires are bent (See Figure 2), in

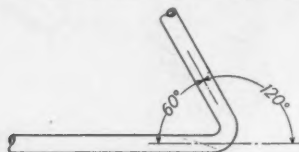


FIGURE 2

which we measure the angle as 120° and not 60°:

While there is no rule against this (assuming that the conduit could be bent

so sharply and still not be damaged as prohibited by Section 3470), there undoubtedly should be such a rule to keep some unfortunate individuals from attempting to pull wires around such sharp bends.

CABLE MUST FILL HOLES

Q. "When using non-metallic outlet boxes with non-metallic sheathed cable, the rules do not require that the cables be clamped to the boxes if the cables are strapped within six inches of the outlet. In some cases, the wires do not completely fill the holes through which they enter the boxes. Is any additional closing required?"—S.D.K.

A. Yes, the final sentence of Rule 3716 very definitely states that the openings through which the conductors or cables enter the boxes, shall be

adequately closed. This means that where there is any appreciable amount of space between the wires or cables and the edges of the holes, that space must be closed.

One way would be by the use of the proper type of cable clamps which are so designed as to close the spaces left by the wires. Or, in order to conserve the metal of cable clamps, loom could be used over the wires to build them up to the diameter of the holes or, tape could be used for this purpose.

SERVICE FOR FIRE PUMPS

Q. "My company has purchased in Pennsylvania, a second-hand fire pump, driven by a 100-220 volt, 3 phase a.c. motor. Are there any special Fire Underwriters' Code requirements regarding the electrical installation on this type of pump, especially in reference to service requirements."—R.E.

A. Regulations by the Board of Fire Underwriters for the installation and operation of centrifugal fire pumps (Pamphlet No. 20), require in Sections 200, 201 and 202, that where a fire pump is electrically driven, the power station and transmission lines must be highly adequate and free from all danger of interference in order to guarantee continuous operation and that there may be nothing to cause an interruption of the service to the fire pump.

Where there is doubt as to the adequacy of the power station or its safety from fire, Section 201C (of Pamphlet No. 20), requires that the service shall be obtained from two or more power stations.

The adequacy of the transmission lines is also required by Section 202 and the second fine print note states that where current is taken from a lighting company's underground supply line, two separate services are required to meet this degree of adequacy.

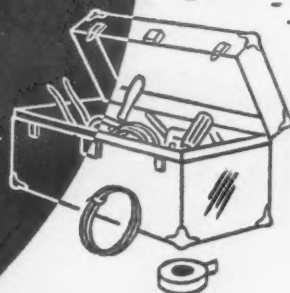
In communities where the lighting



AMONG THE OLD TIMERS at the Eastern Section Annual Meeting IAEL were V. H. Tonsley, Sec'y. of IAEL and A. W. Hopkins, Treas. of Eastern Section. Mr. Hopkins' inspector activities date back to 1908 when he was appointed City Inspector of Springfield, Mass., a position which he held for 30 years. He was made an honorary member of IAEL upon retirement in 1938. He still remains Treasurer of the Eastern Section, a post he has held for 22 years.

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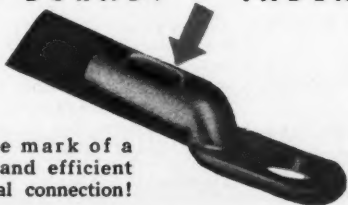
● A small wire connection can be made in several ways. But the simplest, surest way is with a Burndy HYDENT solderless connector.

That's why this Burndy HYTOOL (indenting pliers) will be standard in every electricians' kit . . . very soon. It will simplify and save time connecting up; and it will insure a trouble-free connection . . . stronger mechanically and more efficient electrically than by any other method!

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107 EASTERN BOULEVARD, NEW YORK 54, N. Y.

Electrical Contracting, December 1943

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Don't waste valuable production time while workers look for power outlets for portable tools. Don't risk accidents due to tripping over long cords, or shorting tangled cables.

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company maintains an underground secondary distribution network system, some inspection departments consider such a network to have the required degree of adequacy and instead of requiring two sets of service supply lines or even an entirely separate service line from the network for the fire pump motors, permit the fire pump motors to be connected to the building service lines provided the connection for these motors is connected to the service line ahead of the building service equipment. This, of course, requires a separate service switch.

These rules also require that circuit breakers be used for the over-current protective devices and the use of fuses is prohibited and that the circuit breakers be in addition to the service switch and to the motor starter. Also the circuit breakers are the only over-current devices permitted in the motor circuit which thus prohibits over-current units in the motor starters. The starter, however, must have a no-voltage release.

While these are some of the more important requirements, a careful study of Pamphlet No. 20 should be made in order to be familiar with the other important requirements.

MOTOR PROTECTION

Q. "I would appreciate knowing if we can place two single phase overload protection thermal switches to protect a 3 phase motor between the motor and the motor switch."—H.S.

A. No. Two or three single phase protective devices other than fuses cannot be used to protect three phase motors unless they are so arranged as to simultaneously open at least two of the ungrounded phase wires when any one of them operates. This is required by Section 4328 of the Code.

OFFICIAL INTERPRETATIONS

by the
Electrical Committee of the N.F.P.A.

Interpretation No. 249

QUESTION . . . Is it the intent that the ampere values in Tables 1 and 2 of the 1940 edition of the National Electrical Code and in Interim Revisions Nos. 41, 63 and 77, for allowable current-carrying capacities of conductors, be considered maximum values for computing loads on conductors of the given sizes?

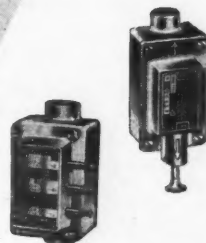
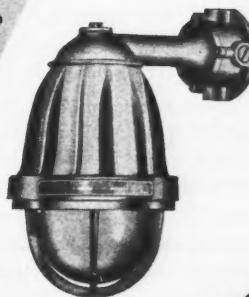
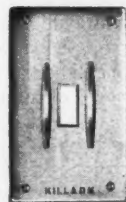
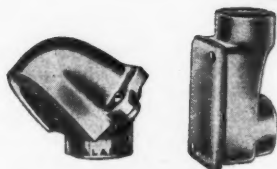
ANSWER . . . Yes.

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TEMP-O-RISE THERMOSTAT

This thermostat embodies two principles in fire detection, one principle working on the rate of rise of temperature for early detection of a fast burning fire. Also the fixed temperature principle for the detection of slow burning and dangerous smoldering fires which cannot be detected by the rate of rise principle until the flash of the accumulated gases—which may be far too late.

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Each thermostat covers 30 x 30 feet of ceiling space. Approved up to 110 volts AC-DC.

We are manufacturers of Underwriters' Approved Fire Alarm products covering the entire field of fire protection. Class A proprietary systems . . . Non-code fire alarm systems . . . all classes of switches and coded transmitters for supervision of automatic sprinkler equipments . . . complete thermostatic fire alarm systems . . . watchman supervisory systems . . . manual fire alarm systems.

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CENTRAL STATION SIGNALS, INC.

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New York 10, N. Y.

Lighting Chicago's New Subway

[FROM PAGE 29]

proximately 15 feet along each platform edge. Other units forming a total of 1,720 are installed at critical locations to provide sufficient illumination for reasonably safe movement of the public during a failure of the regular lighting system. These fixtures are on continuously to assure operation when needed and to supplement the regular illumination.

Tunnel Lighting

Between stations, train tube illumination is provided by two rows of 60-watt incandescent lamps—one row on each side with units spaced approximately 30 feet apart and alternately staggered to provide a tunnel light every 15 feet. Each fixture, consisting of a simple cast iron bracket, is shielded to prevent interference with the motorman's vision. Every fourth light in the tunnel is on a 600-volt d.c. emergency circuit, with 56-watt railway type lamps connected five in series in a group.

Provision is made at the subway portals, where the elevated tracks enter the underground tunnels, for high intensity lighting for a distance of approximately 175 feet inside the tunnel. Floodlights, controlled by photoelectric cells mounted just outside the portals, are used only in the daytime to ease the transition of the motorman's vision from daylight to tunnel light.

Proposed Installations

This modern lighting design in Chicago's first subway venture is typical of that proposed for the second link, completion of which was halted by the war, and for future extensions. The City and the Department of Subways and Superhighways with its staff of engineers are justly proud of the job they have done. Their pioneering venture in the application of fluorescents to subway lighting has elicited many favorable comments from engineers and lighting experts. It may well become the model of future subway lighting design.

Chicago's new subway was constructed under the supervision of Philip Harrington, Commissioner of Subways and Superhighways, City of Chicago. Joshua D'Esposito, as PWA Project Engineer, represented the Federal Government.

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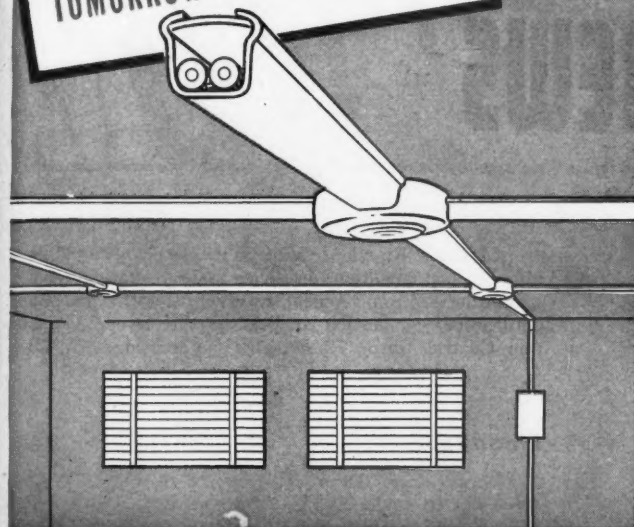
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**TODAY
TOMORROW**

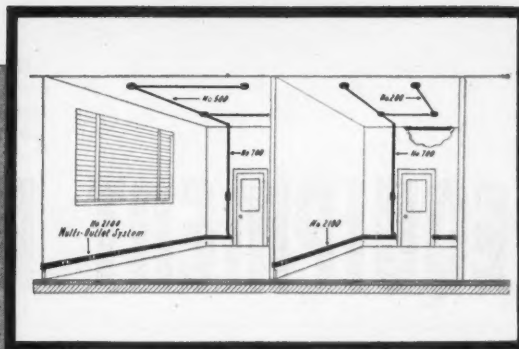
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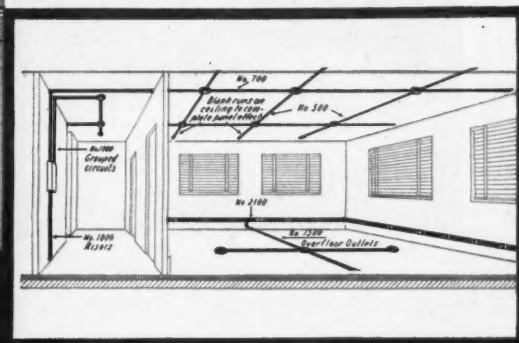
KNOW YOUR
WIREMOLD
AND YOU KNOW THE ANSWERS

● Better lighting, in the factory, in offices, in trade and vocational schools . . . wherever essential productive work and training is being done . . . is one of the "musts" in the war production program. That entails wiring and rewiring problems that can most easily be solved with basic Wiremold Surface Metal Raceway Wiring Systems . . . quickly, economically installed on the surface . . . with few simple fittings . . . with minimum use of critical materials . . . without, in most cases, disturbing progress of work.

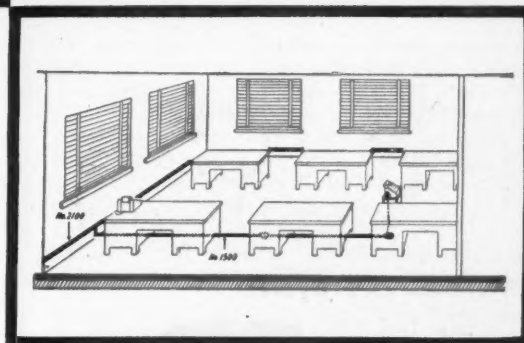
Wiremold is Listed by U. L. and conforms to Federal Specifications W-R-32 . . . assures safe, permanent installation yet can be easily extended or relocated to meet the changing needs that will surely come with reconversion to peace-time operation.



Typical small office, hospital or hotel room installations of WIREMOLD together with PLUGMOLD plug-in-anywhere convenience outlet system.



Installation in larger office or factory working area, showing use of WIREMOLD wiring for light, with PLUGMOLD around baseboards and PANCAKE overfloor wiring for telephones or power.



Installation in executive offices showing PLUGMOLD plug-in-anywhere convenience wiring interconnecting with PANCAKE overfloor wiring to office machines.

Write for your copy of the Wiremold Catalog and Wiring Guide detailing this and other Wiremold aids to greater lighting and electrical efficiency. The Wiremold Company, Hartford 10, Conn.



WIREMOLD

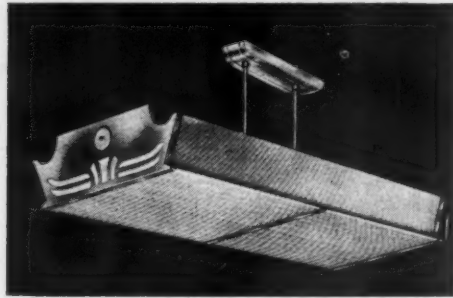
CAN HELP YOU

PRODUCE FOR WAR . . . AND PLAN FOR PEACE



THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of **ELECTRICAL CONTRACTING** you saw the item and they will send full details to you.

EQUIPMENT NEWS



MITCHELL FLUORESCENT FIXTURE

Commercial Fluorescent Fixture

A new, improved lightweight U.R.C. Research luminaire, designed in accordance with latest WPB regulations, is now available for stores, offices, buildings and institutions on a priority of A-1-J or higher. This shielded 200-watt four light commercial fluorescent fixture combines high intensity illumination with low surface brightness and eliminates excessive glare. It is adaptable for every type of interior—for surface or pendant mounting, for individual or continuous row lighting. Unit is easy to relamp and maintain. Glass panels are removed for cleaning or relamping without the use of tools. Starters are replaceable without disturbing lamps. Wiring channel is accessible by removing two wing nuts. Mitchell Manufacturing Company, 2525 Clybourn Avenue, Chicago 14, Ill.

Photoelectric System

Fireye Type F28C is a photoelectric system for providing instantaneous fuel cut-off in any pressure-fed burner in the event of flame failure. It is capable of monitoring flame of any intensity and the system is applicable to oil, gas or pulverized coal burners. It is used with manually ignited burners to cut off fuel and



COMBUSTION PHOTOELECTRIC SYSTEM

sound an alarm; or with program relay Type R25, to program fuel pump and valve operation, intermittent ignition system, purging period and recycling. Designed to operate at relatively high ambient temperatures, it is mounted directly on furnace wall and watches the flame through a

window in the wall of the fire chamber. While the electric eye sees flame, Fireye feeds fuel to the burner. Should flame fail, or any condition impairing safe operation develop within the electronic control, Fireye cuts off the fuel supply until proper combustion conditions are restored. Combustion Control Corp., 77 Broadway, Cambridge 42, Mass.

Floodlight

A heavy-duty, 200- or 500-watt steel floodlight, built to specifications for shipboard use, has been announced. The reflector has a chemically deposited silver coating backed with a coating of silver applied by an electrolytic process and protected by a fired enamel backing. An armor coating of electrolytically deposited metal makes entire assembly shatterproof. Weatherproof operation is obtained through the use



G-E FLOODLIGHT

of a heat-resistant door glass, special impregnated heat-resistant gaskets, and strong door clamps. Mounting for the 200-watt, Type L-29 floodlight is of the swivel and rocker type, with oval base. A tooth lug on the side allows locking at a vertical angle. The 500-watt, Type L-30 comes with a trunnion bracket formed of channel section steel and oval base mounting. This provides a shock-resistant mounting. General Electric Company, Schenectady, N. Y.

Fuse Puller

Notched edges that provide a positive grip is the feature of this newly designed "Safe-T-Grip" fuse puller. It is made of light weight fibre assembled with brass eyelets. It eliminates the danger of shock when pulling and replacing cartridge fuses by hand or handling other "live" electrical parts. Prevents bending of fuse clips through improper removal. Also handy for adjusting loose cutout clips. They are made in four sizes—"Midget" size for handling small fuses, grid leaks, etc., 1/4-in. to 1/2-in. in diameter; "Pocket" size for handling fuses 0 to 200 amperes, 250 volts and 1



IDEAL "SAFE-T-GRIP" FUSE PULLER

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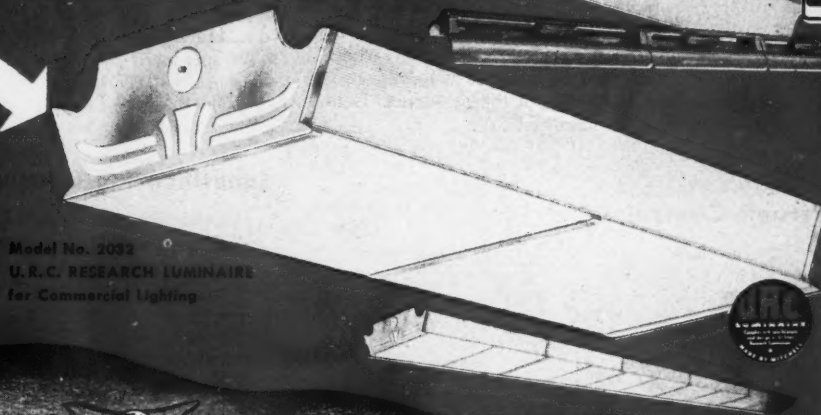
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TODAY'S FINEST
FLUORESCENT FIXTURES
FOR Industrial AND
Commercial LIGHTING



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MITCHELITE—First all-purpose "lightweight" fluorescent fixture for wartime industry! Provides for every method of mounting or hanging.
3 models: 2 and 3-light units using 40-watt lamps; 2-light unit using 100-watt lamps. *Fleur-O-Lier Approved.*

MITCHELL U.R.C. RESEARCH LUMINAIRE—Combines the ultimate in high intensity with low surface brightness (glare). Pendant or surface mounting. Uses four 40-watt lamps. Takes less time to install than any other commercial fixture. Less than 6 lbs. of metal. Available now at the same original low price.

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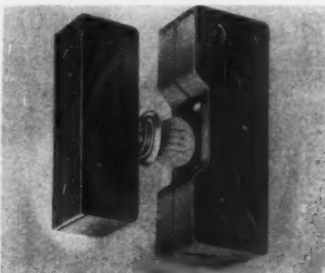


MITCHELL Manufacturing Company
2525 CLYBOURN AVENUE • CHICAGO 14, ILLINOIS

to 100 amperes, 600 volts; "Giant" size for handling fuses 100 to 600 amperes, 250 volts; and 60 to 400 amperes, 600 volts; "Jumbo" size for handling fuses 200 to 800 amperes, 250 volts and 200 to 600 amperes, 600 volts. Ideal Commutator Dresser Co., 1041 Park Avenue, Sycamore, Ill.

Interlock Switch

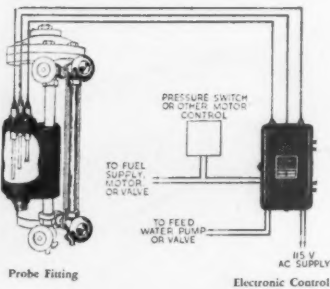
A new door interlock switch, designed as an emergency device to interrupt control circuits where access doors are opened when the power is on, has been announced. It has a carrying capacity of 10 amp., 110 or 220 volts a.c. or d.c. and an emergency opening capacity of a.c. 7½ amp., 110 or 220 volts; d.c. on low inductive circuits, 5 amp., 125 volts; 2½ amp., 250 volts. Application covers a wide range where doors, windows or covers must be interlocked for the protection of the equipment and safety of the personnel. General Electric Company, Schenectady, N. Y.



G-E SWITCH

Electronic Control

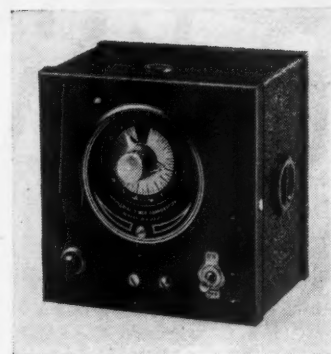
The Fireye electronic feedwater control, Series P156N, is for maintaining constant boiler water levels automatically and for guarding against low-water hazards. For automatic feedwater pump control and low-water protection, it is used with probe fitting Type H53. The probe fitting may be mounted parallel to the water column, or directly on the boiler, and is wired to the electronic control. Types are available also for automatic pump control only, or for low-level protection only. The controls are supplied as standard for boiler pressures to 300 pounds and for operation from a supply of 115 or 230 volts a.c. 60 cycles. The equipment governs solenoid valves, small horsepower pump motors or pump motor magnetic starters. The probe housing is furnished in either cast or malleable iron and the electronic control in a weatherproof pressed steel housing. Combustion Control Corporation, 77 Broadway, Cambridge 42, Mass.



Typical FIREYE Installation For Automatic Boiler Feedwater Control And Low-Level Safeguard
COMBUSTION ELECTRONIC CONTROL

Signalling Timer

The new, Series S, signalling timer is designed to command visual and audible attention the instant a time interval is completed. It is versatile in applications in that it provides for the automatic closing or opening of a circuit at



INDUSTRIAL SIGNALLING TIMER

the end of elapsed time, and operates additional buzzers, bells or lights at remote locations. Socket on side of timer case provides for connection of additional lights or alarms. If circuit closure is required during the time interval, an easily accessible change-over wire and terminal is provided at the rear of the case. Timer is enclosed in a black metal case, readily attachable to any wall or panel or standard switch box. The size is 5- by 5- by 3½-in. deep operating on a.c., 115-230 volts; 25, 50 or 60 cycles, 1000 watts. Motor is slow speed, self-starting synchronous type. Industrial Timer Corporation, 117 Edison Place, Newark, N. J.

Identification Coatings

To expedite the wiring of electrical equipment, a group of colored identification coatings for tracer wire applications, known as the S-18 identifiers, has been announced. It can be applied by running the wire through the varnish or by dipping the entire coil of wire in it. It gives a smooth finish and dries quickly, permitting handling in less than one minute after application. These identification coatings can be supplied in any color. The Sterling Varnish Company, 122 Ohio River Bldg., Haysville, Pa.

Portable Oil Tester

An improved 30,000 volt portable test set for testing of insulating liquids such as oil and Pyranol has been announced. The set, designed for indoor service, provides test voltage from 0 to 30,000 volts on single-phase, 115- or 230-volt, 25 or 60 cycle circuits. It can be used in industrial plants, central stations, substations and wherever frequent oil testing is required. The tester combines in a single unit a step-up transformer, a potentiometer which raises the test voltage, a voltmeter to measure breakdown values, an automatic circuit breaker and an oil testing receptacle. When test sample breaks down, the low-voltage breaker automatically opens the circuit, preventing continuation of arc and burning of electrodes. General Electric Company, Schenectady, N. Y.



G-E PORTABLE OIL TESTER

LOOK AROUND YOU and LOOK AHEAD

FROM TRANSFORMER TO POINT OF LOAD...

TRUMBULL

distributes... controls... safeguards
POWER IN INDUSTRY



Motor Circuit Switches

**ENCLOSED BUS BAR
DISTRIBUTION SYSTEMS**



"AERATED" L. V. D.

Low Voltage Drop System for power distribution in main circuits.

"A switchboard running the length of the plant".



Control Centers. Prefabricated Motor and Feeder Circuit Control



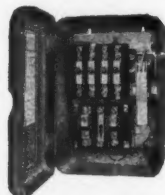
Manual Motor Starters



FLEX-A-POWER

for distribution of electric power in secondary circuits, and to points of load through Flex-A-Plugs.

"A panelboard running the length of the plant".



Magnetic Motor Starters



Panel Boards



Combination Magnetic Starters and Disconnects



Switchboards



"AT" Enclosed Industrial Circuit Breakers



The equipment shown on this page represents some of the major contributions Trumbull engineering has made toward MORE EFFICIENT power distribution and control in industrial plants. This equipment is today helping Industry maintain peak PRODUCTION for war. Tomorrow it will help Industry produce ECONOMICALLY and PROFITABLY for post-war markets.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY. PLAINVILLE, CONN. A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. - SEATTLE - SAN FRANCISCO - LOS ANGELES



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Chances are that out of the many motors we're now making for battle service, we've got one to fit your needs. If not—Westinghouse is ready to design a new one or to adapt an existing type to fit your job . . . and do it without false starts or lost motion. Our experience in matching motors to battle jobs is at your disposal. Call or write your nearest Westinghouse office. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-21290



Watch Your Return

[FROM PAGE 32]

ized had better watch his step carefully for the duration. The contractor doing business on a more conservative investment has the edge on him today. Study these figures and learn why.

Electrical contractor A had a volume in 1942 of....	\$300,000
Upon which he earned a net profit of.....	6%

Electrical contractor A's net profit for 1942 in dollars	\$18,000
--	----------

Electrical contractor A has a capital investment of	\$400,000
\$18,000 represents a return on capital investment of.....	4½%

Electrical contractor B had a volume in 1942 of \$300,000	
Upon which he earned a net profit of.....	6%

Electrical contractor B's net profit for 1942 in dollars	\$18,000
--	----------

Electrical contractor B has a capital investment of	\$200,000
\$18,000 represents a return on capital investment of.....	9%

B is the best business manager because he makes his invested dollars work harder than A and this is the ultimate yardstick of business efficiency, even in normal times.

In some cases reviewed on a recent field study, the investment carried water, which gave the contractor an erroneous conception of earnings. If your net worth is inflated, you may be earning a bigger return than you figure but the water therein obscures the fact. For example, if your net worth, otherwise, your invested capital, is \$225,000 on paper and carries \$45,000 inflation, and your net profit on sales is \$9,000, you will figure you earned 4 per cent on investment. But your net worth with the water squeezed out of it, say it deflates to \$180,000, so the \$9,000 net profit on sales is a 5 per cent return on investment. On the other hand, if your net worth is less on paper than it should be, the return on investment will be exaggerated so you see it is very important that you check the accuracy of your invested capital. In the final analysis, you

are interested in the return you get for your investment in your business.

This problem will project itself into the postwar period when heavy demand, long bottled up, will necessitate expansion and modernization of working equipment, rolling stock and buildings for many contractors. Suppose electrical contractor A with a volume of \$300,000 invests \$40,000 in new trucks, tools in adequate quantity to keep labor cost at minimum, new fixtures and an addition to building, and that he increases sales that year by \$40,000, also net profit from 4 to 5 per cent, hence, sales would be \$340,000 and net profit \$17,000, which, on an investment of \$400,000 would be 4.2 per cent earnings. Electrical contractor B invests \$40,000 in a similar modernization program and increases sales from \$300,000 to \$340,000, or \$40,000, also net profit from 4 to 5 per cent, of \$17,000. His return on \$300,000 investment is 5.6 per cent so he would earn ½ more on his invested capital although in profit-dollars, the return would be the same in both cases. This indicates that the profit on modernization depends to some extent on your capital investment and explains why some contractors in bygone years complained that modernization of tools and other business assets did not get the results expected whereas others reported excellent results. It is obvious that the contractor who depends entirely upon the net profit on sales to tell him whether he is profiting on a modernization program, an advertising investment or other monies sunk in a business will often get an erroneous answer.

Recently, we made a survey among eastern electrical contractors to get a line on capital investment earnings and our survey work sheets show this result. In 1942, one contractor (A) earned 4.7 per cent on sales and 6 per cent on investment, another (B) earned 2.8 per cent on sales and 7.4 per cent on investment, another (C) earned 4.2 per cent on sales and 11.9 per cent on capital invested. Figured by the usual yardstick, profit on sales, it would seem that A did the best managerial job but this is erroneous because the ratio of net profit to capital invested is the ultimate measure of profitability today, not necessarily the profit on sales, although this should be considered. C was the best business man. He got more out of his invested dollars than A or B.

The profit and loss statement and balance sheet shown here give a bird's eye picture of how to compare profit on sales with profit on investment. Take both figures into consideration from now on if you want to survive the duration and bridge the postwar period safely.

TWO AND FOUR LIGHT OPEN AND CLOSED TYPE FLUORESCENT COMMERCIALS

Now Available with CONVENTIONAL OR INSTA-START BALLASTS!

LIGHTING PRODUCTS new Commercial and Industrial Fluorescent Fixtures are now available with either the new Super-Powered Insta-Start or Conventional Type Ballasts.

The new Insta-Start Ballasts operate on standard 40 and 100 watt fluorescent lamps and carry the full year guarantee of a leading transformer manufacturer.

Insta-Start units reduce maintenance by the elimination of starter switches and turn on and off like an incandescent light. Not only will they operate on as low as 85 volts where line load is a problem but they also are not affected by zero temperature or drafts. The above units comply with WPA regulations and are now available for shipment.

Write today for complete information on this new line.

L.P.I.—U.R.C. Four light
Luminaire. Mountings—
Pendant or surface—
Individual or Continuous.

Flat Type-2 or 4 Light for
Surface or Pendant
Mounting

Half Round-4 Light for
Pendant or Surface
Mounting

L.P.I. Fluorescent fixtures furnished
with Conventional or Insta-Start
Ballasts

LIGHTING PRODUCTS, INC.

HIGHLAND PARK • ILLINOIS

IN THE NEWS

FURTHER WPB DECENTRALIZATION

Outlining further details of its program for decentralizing activities, the War Production Board has announced that applications for beginning industrial, as well as non-industrial construction, where the cost of the project is \$10,000 or less, are to be filed with and processed by the field offices. Applications should be filed with the Regional or District Office nearest the location of the project.

The authority, extended to the field offices (with certain exceptions listed below) also covers amendments to applications increasing the cost of a project to \$10,000 or more, provided the increase is not more than 50 per cent above the original estimated cost.

However, amendments to applications which had originally been processed by WPB in Washington will not go to the field offices. This is intended to eliminate unnecessary referral of records from Washington to the field.

Until now, field offices had processed only applications for projects of a non-industrial nature up to a value of \$10,000. Plans now being formulated contemplate increasing the authority of the field offices to process both non-industrial and industrial applications above the \$10,000 level.

The authority concerning construction applications, outlined in Field Administrative Order 708-20 as amended, also gives the Regional Directors the power to issue stop construction orders and revocations of preference ratings, in the name of the War

Production Board, where the project was authorized by the Regional office.

The Appeals Boards in each of the regions are changed to Review Boards, which have the power to approve or deny appeals from actions taken in any office of the WPB in a region, or appeals from final adverse actions taken by any agency doing screening work for the WPB in the region. This reviewing authority, however, does not extend to actions taken by the National Housing Agency relating to programmed war housing.

Types of construction for which applications are not to be processed in the field, even if the cost is under \$10,000, are:

1. Applications under the jurisdiction of the Petroleum Administrator for War.
2. Applications by the Federal Public Housing Administration.
3. Applications for which the Office of War Utilities is the division of first reference.
4. Projects financed by Defense Plant Corporation for which the Aircraft Resources Control office is the division of first reference.
5. Applications for which the Mining Division is the division of first reference, where construction below ground is involved.
6. Applications for which the Transportation Equipment Division is the division of first reference, where railroad tracks together with necessary operations facilities and other equipment restricted by Order M-126 are involved.
7. Applications for which the Radio and Radar Division is the division of first reference, where intercommunication, public address, broadcasting, and other sound systems are involved.
8. Applications for blanket authority to begin construction in accordance with the terms of WPBI-43 (formerly PDL-362).
9. Applications for projects involving fire protection equipment or dust and fume control systems.
10. Applications which include production machinery and processing equipment.
11. Applications for projects which are to be financed wholly or in part with Federal funds.

(Of the types of projects listed above which will come to Washington, instead of the field, those numbered 1, 4, 5, 6, 7, 9, and 10 are added by the amended order. Types listed under 2, 3, 8, and 11 previously came to Washington when only non-industrial applications had been decentralized.)

The new field administrative order also points out that the Regional Directors are to follow the policies established by the Washington office with respect to the essentiality of projects and the processing of applications.



MOTOR SPECIALISTS from Bloomington, Ill., Eugene Struck (left), owner and R. D. Ummel, shop foreman of the Electric Motor Repair Company, handle a large majority of that city's motor service problems.

Decentralization of processing of construction applications forms a part of the general program to speed WPB's operations by gradually increasing the responsibilities of the Regional Directors and the Regional offices. As announced last month, PD-1A applications (general-purpose priority applications) and PD-333 applications (emergency assistance) are to be processed largely in the field offices. Details regarding these two forms will soon be announced by the War Production Board.

Plans for decentralization of appeals from WPB L, M, and other mandatory orders, also announced last month, have already been effectuated by amendment of Priorities Regulation No. 16.

FUEL CONSERVATION RESTRICTS XMAS LIGHTING

The American people have been asked by J. A. Krug, Director of the Office of War Utilities, to confine Christmas lighting decorations to Christmas trees inside private homes.

He asked that street decorations, community Christmas trees, exterior home decorations and interiors and exteriors of commercial establishments dispense with decorations this year insofar as lighting is concerned.

"Government and industry have combined in a nationwide conservation campaign to save critical fuels and materials necessary to produce and consume electricity. I am asking the American people to refrain from their Christmas lighting custom as a part of that campaign. Electric light bulbs are particularly short at present and strict conservation of them is necessary. Widespread consumption of bulbs during the



NEW CHIEF electrical inspector for the city of Minneapolis, Minn., S. Martin Streed occupies his spare time by teaching the N. E. Code and lighting and power wiring at Dunwoody Institute.

ONLY AN ELECTRICAL WHOLESALER COULD THUS SPEED WAR PRODUCTION



Wesco know-how revamped ordnance plant layout

New Electric System Ended Installation Delay; Sped Urgently Needed Capacity

In Wisconsin, contractors rushed to complete an important ordnance building. Plans for the electrical system specified a Vapor-proof 600-volt fusible distribution panel. The local Wesco house, called in on the job, advised that no such panel is made in fusible type nor was there a suitable substitute in 600-volt ratings.

Instead, Wesco suggested using individual AB Vapor-tight Breakers, ganged up, and a Vapor-tight junction box for main feeder. The revised system as laid out was at once approved, equipment was promptly delivered and the installation completed without delay. Initial production in the ordnance works was advanced by many hours.

Wesco's job is not only to know thoroughly every detail of electrical wholesaling, but to help customers solve their many and difficult electrical problems. Today, this know-how is devoted to winning the war. After Victory, Wesco's 80 Branches will stand ready to help industry and business convert to the big peacetime job that lies ahead.

WESCO SPEEDS WAR PRODUCTION

- * Production of mosquito boats was threatened by a paralyzing 45 to 60 day delay in obtaining vital cable. Wesco located and delivered the necessary cable—in 24 hours!
- * Wesco rushed 68 separate electrical items to an airfield in 3 days—81 days faster than the best promised delivery by manufacturers.

WESCO SERVES BUSINESS

- * By providing trained sales and engineering personnel.
- * By warehousing stocks in anticipation of customers' needs.
- * By assembling all parts of an order in one shipment.

**DONATE YOUR BLOOD
AND SAVE A FIGHTER**

Westinghouse Electric Supply Co.

150 VARICK STREET . . NEW YORK (13), N. Y.

A NATIONAL DISTRIBUTING ORGANIZATION WITH 80 BRANCHES

Christmas season merely will mean a greater scarcity later on.

"Because of the shortness of daylight over most of the country at Christmas time, necessary consumption of electricity is at its peak. Everything we can do to avoid any additional load will mean direct savings of fuel, manpower, transportation and materials."

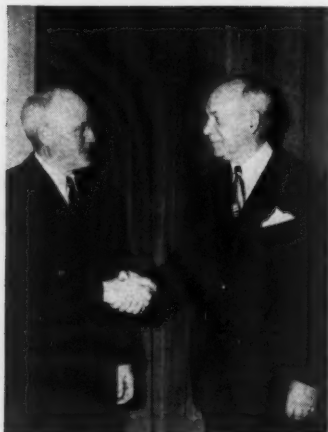
No mandatory order has been contemplated because "the American people realize the necessity of this conservation and will do it."

COPPER SCRAP FORM WPB 452

To cut down on paper work, the War Production Board has issued Supplementary Order M-9-b, as amended, providing that generators of copper scrap amounting to 5,000 pounds or more per month report on Form WPB 452. Heretofore those generating 500 pounds or more were required to file. The total amount of scrap effected by the change will amount to only about 2½ per cent of the total which was previously reported. In no event shall any person keep on hand more than a 30-day accumulation unless such accumulation aggregates less than one ton.

NEMA ELECTS KEBLER

Leonard Kebler, president, Ward Leonard Electric Co., Mount Vernon, N. Y., was elected president of the National Electrical Manufacturers Association at the concluding session of the Association's annual meeting at the Hotel Waldorf-Astoria, Oct. 25-29. Mr. Kebler succeeded Max McGraw, presi-



NEW PRESIDENT—Leonard Kebler, president, Ward Leonard Electric Co., who was elected president of NEMA, receives the congratulations of his predecessor, Max McGraw, president, McGraw Electric Co., Chicago.

dent, McGraw Electric Co., Chicago, Ill.

Five vice-presidents elected were: V. R. Despard, vice-president, Pass & Seymour, Inc., Syracuse, N. Y.; C. R. D'Olive, manager, household appliance division, Stewart-Warner Corp., Indianapolis, Ind.; C. W. Higbee, manager, wire and cable department, U. S. Rubber Co., New York, N. Y.; D. G. Phelps, vice president, Colt's Patent Fire Arms Mfg. Co., Hartford, Conn., and A. C. Streamer, vice-president, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

F. T. Wheeler, vice-president, The Trumbull Electric Mfg. Co., Plainville, Conn., was re-elected treasurer.



VINCE KOUTNIK, in charge of electrical construction work for Anderson Electric Co., Manitowoc, Wis., checks over government reports with his bookkeeper. Vince does primarily industrial extension and maintenance work in Manitowoc industries.

AMENDMENT TO MPR 136

The Office of Price Administration has clarified the meaning of base date prices used by manufacturers, sellers and lessors to compute ceilings for new machinery and machinery parts.

Maximum Price Regulation 136 (Machines and Parts and Machinery Services) froze "confidential list prices" in effect on the base date specified in the regulation. For the purpose of simplicity this new action establishes maximum prices by reference to "established prices" in effect on the applicable base date instead of confidential list prices.

The term "confidential list price" had been interpreted by OPA as including prices that have been repeatedly quoted or charged, which is in effect the freezing of established prices.

All persons covered by the regulation who have not already done so, are required to file with OPA on or before December 3, 1943, all published list prices and discount sheets in effect on the base date for the sale or rental of machines or parts.

Under the new action, the meaning of



NEWLY APPOINTED executive secretary of NISA, Fred B. Wipperman, St. Louis, urges Chicago motor shop men to fight to the limit for deferment of their key men.

"established price in effect on the base date" is:

(1) a price which had been quoted or charged to the same class of purchasers more than twice during the six months' period prior to and including the base date and which was not increased on or before that date;

(2) a price which had been quoted or charged to a different class of purchasers more than twice during the six months' period prior to and including the base date, and which was not increased on or before that date, adjusted to reflect the base date differential between the two classes of purchasers, or

(3) a price which would have been quoted on the base date, under a system of quoting prices without further cost computation.

ORDER L-41 REDRAFTED

A completely re-drafted Order L-41, which limits construction, has been issued in simplified form by the War Production Board. The new language of the order is intended to make the restrictions more easily understandable by the public.

Typical of the language of the revised order is its introduction, explaining the purpose of L-41: "This order limits construction. It is necessary in order to conserve materials, construction equipment, labor, and transportation. In most cases, except where the construction is of a special kind, you must get permission from the War Production Board for construction."

The introduction goes on to explain that this permission is not to be confused with preference ratings or priorities: "If a construction job is allowed, either because it is not of the kind restricted by the order or because permission has been obtained, it may still be necessary to get preference ratings for the materials and fixtures which are needed. On the other hand, if you have ratings for materials, or materials on hand,

Non-Metallic WIRING

**MAKES MORE
CRITICAL
METALS
AVAILABLE FOR
FIGHTING
EQUIPMENT**



**Porcelain
PROTECTED WIRING
SYSTEMS**

★ Planes, tanks, guns, and other armament must continue to flow in an endless stream to widespread fronts. Now while there is this necessity, steel and other critical materials must be conserved—the more there is available, the more implements of war are produced.

One way to conserve more of these critical materials is through non-metallic wiring as specified in numerous directives by WPB.

Porcelain Protected Wiring Systems are the answer.

These systems are time-proved. They have demonstrated their permanence, safety, and economy in thousands upon thousands of installations in all parts of the country. Contractors have found that porcelain protected wiring systems are simple to install—that they assure good profit—that they create good will of customers.

Porcelain is short-proof and shock-proof—rust- and corrosion-resistant—performs dependably in damp, wet, or dry locations.

You can handle and speed wiring jobs, beginning now for all types of construction. Consider the value of porcelain for the future when war's end will mean thousands of industrial, commercial, and residential wiring jobs. For details, write to the companies listed below.

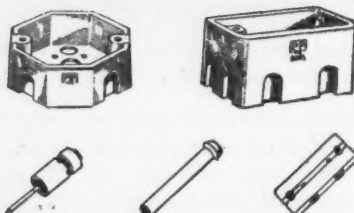
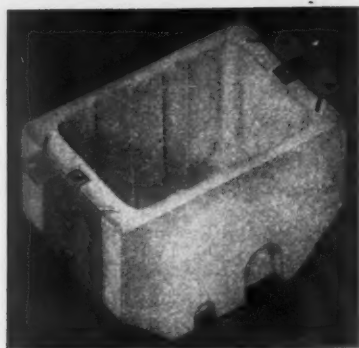


MODERN PORCELAIN PROTECTED WIRING SYSTEMS

★ ILLINOIS ELECTRIC PORCELAIN CO.
Macomb, Ill.

★ KNOX PORCELAIN CORPORATION
Knoxville, Tennessee

★ PORCELAIN PRODUCTS, INCORPORATED
Findlay, Ohio



Porcelain Meets WAR HOUSING Requirements for Non-Critical Wir- ing Materials

The War Housing Critical List, the Critical Materials Design Guide, the List of Prohibited Items for Construction Work, War Department Specifications—all require the use of non-metallic, or PORCELAIN Outlet Boxes and non-metallic type, or Knob and Tube Wiring Construction.

You can speed installation of every wiring job by stocking Porcelain Products' Porcelain Outlet Boxes, Surfolets Knobs, Tubes, Cleats and other non-metallic wiring materials.

Write for your FREE copy of Installation Manual on Porcelain Protected Wiring Systems.

PORCELAIN PRODUCTS, INC.
FINDLAY, OHIO

you may still have to get permission to use them for a particular construction job."

In addition to simplifying the regulations and instructions, the revised order makes the following changes:

1. The limit on farm construction, including residential, is placed at \$1,000. Previously, there were separate limits, farm residences not being considered part of the farm unit.

2. A limit of \$200 is placed on any type of construction for which a higher specific limit is not authorized by the order. This over-all limit formerly was \$1,000.

3. The exception, originally made by L-41-b, for the insulating of buildings, has been liberalized in accordance with WPB policy relating to fuel oil conservation. On the other hand, the exception covering the conversion of heating equipment from oil to coal has been eliminated because of the tight coal situation.

4. Minor capital additions under CMP Reg. 5 in certain of the more essential industrial plants are excepted from the L-41 restrictions.

5. In calculating costs to determine if a job is within specified L-41 limits, the cost of used materials, or the value of labor furnished free, need no longer be included.

6. Cost limits now refer to the calendar year, instead of to any consecutive twelve months period.

7. Installation of plumbing equipment rated on WPB-2631 (formerly PD-851) is permitted if the cost is under \$200.

8. Schedule B, listing various kinds of construction relating to operations of farms, railroads, utilities, mines, etc., which may be begun without WPB permission, has been altered in several respects. Drilling of water wells, certain radio facilities, and timber access roads financed wholly or in part by defense highway appropriations have been added.



OIL PUMPING explosion-proof electrical equipment, its installation, control and maintenance, is the daily routine of Jacob Rosenthal, division electrical foreman of the Humble Pipe Line Co. of Houston, Tex.

HERE'S A FINE OPPORTUNITY
FOR SOMEONE . . .

THIS PUBLICATION NEEDS A PROMOTION and RESEARCH MAN

We're looking for an electrical man with a yen to get into advertising and publishing . . . or an advertising man who knows his way around in the electrical business.

We've heard all about the manpower shortage, but somehow we've got a feeling that there's a man around who would welcome this opportunity to get established with one of the world's largest publishing houses . . . McGraw-Hill. This particular job is vacant only because the man who held it has been moved up the ladder. In other words, it's no war baby.

Here's the sort of a man we're looking for. We don't expect to find all these qualifications rolled up into one individual, but the more you have the better.

He likes to write. It's not painful for him to sit at a desk and pour out words. He expresses himself clearly on paper and enjoys doing it. Maybe he has written some advertising, edited a house organ, or handled publicity for a manufacturer—at least enough to get the taste of printer's ink and like the flavor.

He has a liking for research . . . if he hasn't done much of it, at least he is curious enough to want to investigate things, and he has the patience and sound grasp of elementary mathematics that will enable him to supervise tabulations, work out the results in chart form, etc.

He has some technical background. If he's a full blown E.E., M.E., or something that would be fine . . . but all we really insist upon is that he has an understanding of things electrical . . . can go into an electrical contractor's shop and have a reasonable grasp of what goes on.

In replying tell us such facts as your age, draft status, salary desired and anything else that you think will help us fit you into the picture. The job is open right now, so the sooner the better.

ELECTRICAL CONTRACTING

Sales Promotion Dept.

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CONTRACTOR Charles R. Hemby, Hattiesburg, Miss., confines his wartime activities to industrial electrical maintenance. Latest construction project was work at Camp Shelby some dozen miles away.

With issuance of the revised L-41, Orders L-41-a, L-41-b, L-41-c, and Interpretation No. 1 are revoked inasmuch as their provisions are either incorporated into, or altered by, the new order.

APPOINTED CONSULTANT TO WPB DIVISION

The appointment of Kenneth R. Smythe, of Baltimore, as Consultant to WPB's Building Materials Division has been announced by John L. Haynes, Director of the Division.

Mr. Smythe will advise the Division's Lighting and Fixtures Section on production and use of aircraft lighting equipment.

Now serving as electrical and radio engineer with the Glenn Martin Company, Baltimore, Mr. Smythe's former connections include a position with the Douglas Aircraft Company, Santa Monica, California, and the Byllesby Engineering Company, Chicago. He has been closely identified with the aircraft manufacturing industry for the past ten years. He was a member of the RAF in World War I and was active in hydro-electric and steam power plant design work prior to entering the aviation industry.

A.L.A. WANTS YOUR JOURNALS

The American Library Association created in 1941 the Committee on Aid to Libraries in War Areas, headed by John R. Russell, the Librarian of the University of Rochester. The Committee is faced with numerous serious problems and hopes that American scholars, scientists and professional men will be of considerable aid in the solution of one of these problems.

One of the most difficult tasks in



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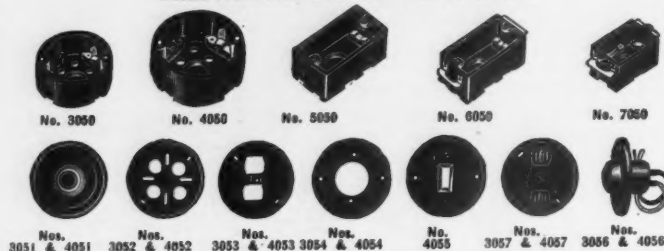
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THAT MEET THE NATIONAL ELECTRICAL CODE AND APPROVED BY
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BOXES FURNISHED WITH OR WITHOUT CLAMPS



SAFE • ECONOMICAL • DURABLE • NEAT

The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one 1/2 in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

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That TRANSMISSION LINE fact you want is **HERE** ➡

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2nd edition of THE **LINEMAN'S HANDBOOK**

652 pages, 6x9, 682 illustrations, \$4.00

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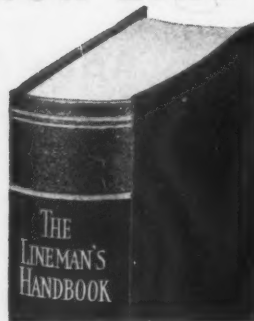
- Elementary Electrical Principles
- The Electric System
- Distribution Circuits
- Line Materials
- Line Equipments
- Line Protective Equipment
- Line Control Equipment
- Fundamentals of Line design
- Pole-line Erection
- Tower-line Erection
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- Rural Lines
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This handbook covers everything the practical man wants to know about every phase of transmission line work. It is a handy volume packed with workable plans, methods, kinks, short cuts, tables, diagrams and photos, on every aspect of materials, poles, towers, stringing, guying, trouble-shooting, first aid, etc. Use it as thousands of other line department workers have—to check your methods against the practice of others, to get fast, dependable answers to problems that arise on the job, to brush up on special points, and for consistent study to improve your knowledge, grade and earnings.

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By Edwin Kurtz



AN EAGER EAR is proffered by James S. Reilly (left), Commission of Public Utilities, Shreveport, La., as Frank G. Camus, city electrician, Shreveport, tells of the successful code panel he led at the recent Southern Section Inspectors' Convention at New Orleans.

library reconstruction after the first World War was that of completing foreign institutional sets of American scholarly, scientific, and technical periodicals. The attempt to avoid a duplication of that situation is now the concern of the Committee.

Many sets of journals will be broken by the financial inability of the institutions to renew subscriptions. As far as possible they will be completed from a stock of periodicals being purchased by the Committee. Many more will have been broken through mail difficulties and loss of shipments, while still other sets will have disappeared in the destruction of libraries. The size of the eventual demand is impossible to estimate, but requests received by the Committee already give evidence that it will be enormous.

With an imminent paper shortage attempts are being made to collect old periodicals for pulp. Fearing this possible reduction in the already limited supply of scientific and technical journals, the Committee hopes to enlist the cooperation of subscribers to this journal in preventing the sacrifice of this type of material to the pulp demand. It is scarcely necessary to mention the appreciation of foreign institutions and scholars for this activity.

Questions concerning the project or concerning the Committee's interest in particular periodicals should be directed to Dorothy J. Comins, Executive Assistant to the Committee on Aid to Libraries in War Areas, Library of Congress Annex, Study 251, Washington 25, D.C.

COPPER ORDER AMENDED

The War Production Board has issued Supplementary Order M-9-c-4, as amended, changing the status of various copper articles.

The amended order is no longer applica-

ble to copper or copper base alloy pipe, tubing or fittings in a building or structure, unless the installation is for plumbing, heating or cooking purposes. Under the narrowed scope of the order it will not be necessary under any conditions for the Copper Division to pass on the installation of air-conditioning, refrigeration or industrial processing systems.

The amended order also prohibits contractors from using copper or brass nails, screws, nuts, bolts, rivets, washers and expansion shields for construction and repair to buildings. However, stores are permitted to dispose of their supplies of these items to anyone for the balance of 1943, but after that only on a rating of AA-5 or higher except for an additional \$25 worth on lower or unrated orders.

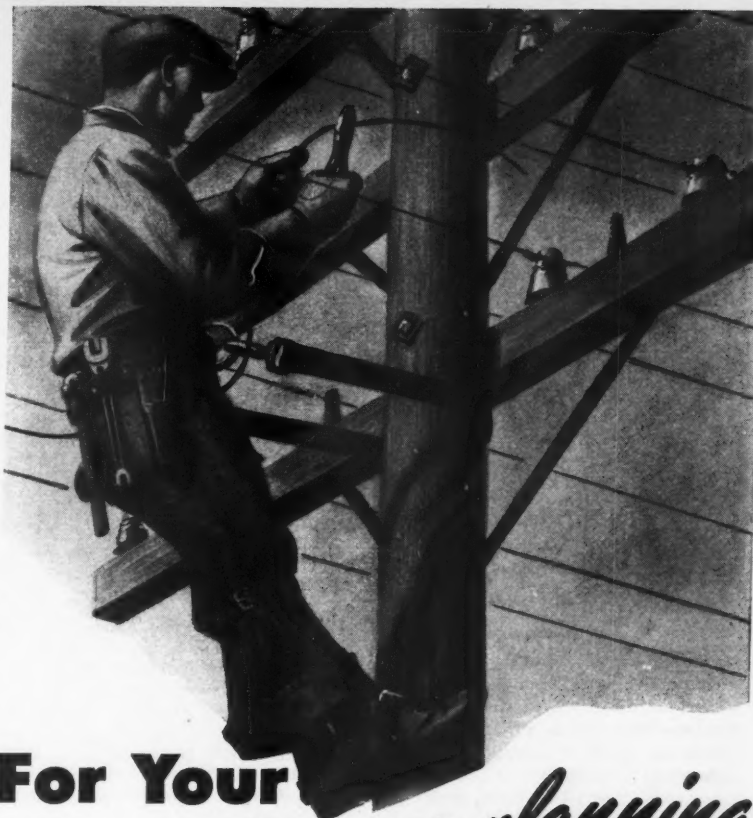
RESTRICTIONS ON MICA USE

Because of a serious depletion in stockpiles of better qualities of mica, the War Production Board has acted to conserve supplies of this material. Users of high-quality mica are being notified that the board will undertake to provide only sufficient quantities of these qualities to maintain consumption at the average rate maintained during the first nine months of 1943. This policy will become effective about December 1.

Stockpiles of the better qualities of mica have deteriorated sharply since the first of the year, the board announced. Average consumption of good stained mica and better qualities for the first eight months of this year has been more than 50,000 pounds in excess of receipts. As a result, Government stocks of certain types of mica used in capacitors are at the vanishing point.



TWO ACTIVE MEMBERS of IAEI attending the Eastern Section Nineteenth Annual Meeting are: W. J. Maban, past president of the International Ass'n., now member of Executive Council, and IAEI representative on NFPA, Emergency and Safety Code Electrical Committees; and J. M. Turnbull, chairman of western N.E. chapter and member of convention executive committee.



For Your *Post war planning* ... KLEIN'S



This booklet on the care of tools is a Klein contribution to making tools last longer—give better service. Write for a copy.

Victories on many fronts point to the day when power and communication companies will be faced with the peacetime problem of extension and re-habilitation.

Today many utility companies are planning for the future and these plans of necessity call for high quality tools and equipment, for linemen and electricians.

Mathias Klein & Sons are busy making the tools and equipment they have always made. When the war is won, this capacity will be available to produce tools and equipment of the same high quality that has characterized the name Klein "since 1857."

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

Since 1857



Mathias KLEIN & Sons

Established 1857

Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

TO PREVENT WRINKLES IN SMALL RADIUS BENDS



Use
GREENLEE
Hand
Benders

- Forms smooth, neat-looking bends up to 180°
- Special clamping device stops kinks
- Sizes for thin-wall conduit (EMT); rigid conduit & pipe; all types of tubing
- Fast, easy to operate

Forming small-radius bends in tubing, conduit, or pipe, without wrinkles, kinks, or serious distortion, is a simple task with Greenlee Hand Benders. They form neat bends for sharp nooks and corners... save up to 75% in time and material on many jobs. Special clamping device prevents slipping... stops kinks. There's a size for most jobs, including powerful hydraulic benders for conduit and pipe up to 4½" size.

WRITE FOR NEW
CIRCULAR S-120



GREENLEE TOOL CO.
1752 Columbia Ave., Rockford, Ill.

Please send full details on Hand Benders—Circular S-120. Also data on hydraulic Benders ☐ Pipe Pushers ☐ Cable Pullers ☐ Knock-out Punches and Cutters ☐.

Name.....

Company.....

Address.....

MAIL COUPON
FOR FULL FACTS
ON GREENLEE
TOOLS

Industry stocks are also reduced, in practically all cases, to a minimum working inventory.

There are six types of mica of which supply is shortest. They are: No. 4 clear and slightly stained block, No. 5 fair stained block, No. 5½ fair stained block, No. 5½ good stained block, No. 5 fair stained film, and No. 5½ fair stained film. All of these are used almost entirely for condenser films. The insufficiency of these types of mica has compelled the Mica-Graphite Division of the War Production Board to draw on other types of mica as substitutes and it will not be long before suppliers will be unable to meet demands for mica. Up to now the Mica-Graphite Division has filled all requests for allocation and it is not aware of any case where necessary war production has been held up because mica could not be supplied.

INTERPRETATIONS OF PRICE REGULATIONS

The Office of Price Administration distributed the 28th of a series of pamphlets digesting interpretations of specific schedules and regulations, other than the General Maximum Price Regulation and Maximum Price Regulation No. 165—Services. Of special interest to the electrical industry are items 80, 82, 84 and 85—

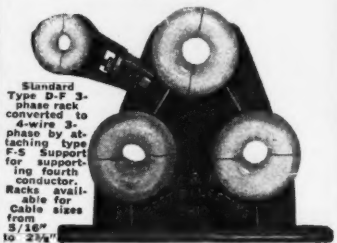
80—Outdoor and indoor substations. The term "outdoor and indoor substations" in Appendix A of the Regulation refers only to portable substations enclosed in metal cages. Therefore, a sale of a portable electrical substation located in an establishment without the good will of the business, is covered by the Regulation as a sale of "machines and parts". However, permanent substations, which are in the nature of fixtures to real property are not covered by the Regulation.

82—Rebuilt motors. Rebuilt motors are "machines and parts" within the meaning of the Regulation. The applicable base date governing sales of rebuilt motors is March 31, 1942, Appendix B, Section 1390.33.



THREE SPEAKERS at Eastern Section IAEE annual meeting in Providence, R. I., are, left to right: M. M. Brandon of Underwriters Laboratories, R. B. Shepard now of WPB and Chief Electrical Engineer of U. L. Inc. and R. S. Moulton of NFPA.

SIMPLICITY PLUS! NEW NON-INDUCTIVE CABLE RACK for INDUSTRIAL PLANT WIRING



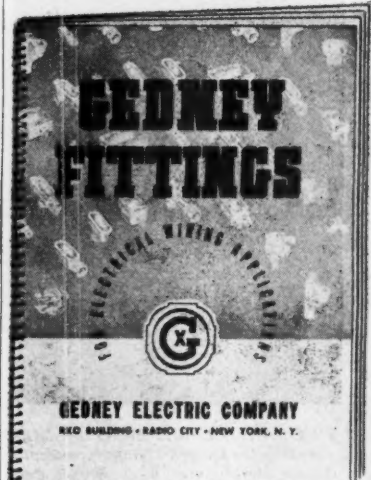
Standard Type D-F 3-phase rack converted to 4-wire 3-phase by attaching type F-S support for supporting fourth conductor. Rack available for cable sizes from 5/16" to 2½".

Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction... installation of cables made quick and easy through the use of split bearings.

Send today for Bulletin C-S-51... describes these and other M. & W. items.
Hook-Mounting and Bar-Type Cable Racks • Messenger Wire and "Bull Dog" Conduit Hangers • "Bull Dog" Insulator Supports • Ground Clamps

**THE M. & W. ELECTRIC
MANUFACTURING CO., INC.**
EAST PALESTINE, OHIO

SEND FOR THIS HELPFUL DATA ON GEDNEY FITTINGS



GEDNEY ELECTRIC COMPANY
RKO BUILDING • RADIO CITY • NEW YORK, N. Y.

"Gedney Fittings Fit"
SOLD THROUGH WHOLESALE

GEDNEY ELECTRIC COMPANY
RKO BUILDING NEW YORK 20, N. Y.



CODE PROBLEMS occupy between session time of C. W. Spain (left), Principal, Building Trades School, Detroit; and Charles Kenig, Electrical League of Cleveland, Cleveland, Ohio, at recent War Conference of Western Section, LAEI in Chicago.

84—Increase in labor costs. Section 1390.7 provides a formula for determining the maximum price of a machine or part for which the manufacturer had no published or confidential list price in effect on October 1, 1941. Where the cost of a commodity for which a maximum price is determined under this section is increased due to labor inefficiency, the manufacturer may increase his maximum price of the particular commodity to reflect the increased labor cost, since a change in efficiency of labor will necessarily affect his estimate of labor hours. The increased price for the commodity must be reported pursuant to Section 1390.18 (g).

85—Discounts—sale through agent. Under Section 1390.20, a seller may not change his customary discounts or price differentials among his classes of purchasers. Where a manufacturer who formerly sold the machines direct to the customer, now sells through a sales agent who does not take title to the machinery, the sales agent is bound by the customary discounts of the manufacturer.

FLASHLIGHT BATTERIES FOR FARM USE

Manufacturers of flashlight batteries have been directed to distribute approximately 20 per cent of their fourth quarter production to farmers. Purpose of the directive is to make flashlight batteries immediately available to farmers throughout the country to assist them in the care of young stock during the winter months.

Batteries now are being made at approximately 50 per cent of the pre-war output and this directive makes about normal rural consumption available through farm outlets. Manufacturers are directed to allocate specific numbers of batteries among farm distribution outlets on the basis of past purchases or other equitable methods.

The directive does not change operation of preference ratings in any other particular and AAA and certain other orders are not affected.



UNDER the hourglass contour of the "Gibson Girl" Automatic Emergency Radio Transmitter of Bendix Aviation, Ltd., important wiring and electrical construction are protected by Irvington insulation.

In designing this new life saving equipment, Bendix engineers had to be sure of its dependability and ability to stand up under a variety of adverse conditions—water, dampness, extreme changes of temperature, and physical abuse. Because of this, preference was given to three Irvington Products which today are providing satisfactory insulation.

HARVEL 612-C INSULATING VARNISH Bendix radio engineers preferred 612-C because their experience had proved that it has exceptional ability to withstand high voltages, humidity, and charring from high voltage flash-overs.

Other advantages which have led many leading manufacturers of electrical equipment to specify 612-C are: it cuts baking time in half on applications involving multiple coats; polymerizes to a solid, infusible state; will not soften or "throw-out" of armatures and other equipment operating at high peripheral speed; has exceptional penetrating power; has good electrical properties; contains no objectionable solvents and has high resistance to acids, alkalis, oils and moisture.

IRV-O-VOLT VARNISHED TUBING—Varnished inside-and-out cotton fabric obtainable in types corresponding to A.S.T.M. grades A-1, B-1 and C. Irv-O-Volt tubing retains flexibility at ordinary operating temperatures; will withstand considerably higher temperatures in semi-rigid or rigid installations.

IRVINGTON VARNISHED CAMBRIC—In addition to possessing high dielectric strength, Irvington Varnished Cambrics are tough and exceptionally resistant to acids, moisture and abrasion. Rigid control of varnish formulations and careful selection of base materials insure their quality.

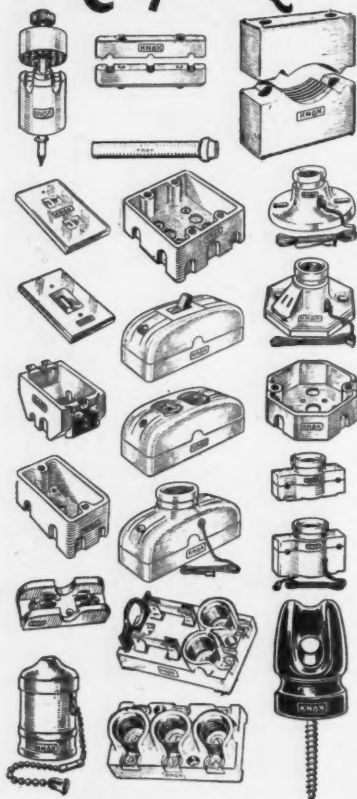
You too, can improve your product by using one or more of Irvington's many insulating materials. For information on the complete Irvington line send for catalog and additional literature. Write Dept. 96.

"THE GIBSON GIRL"... a virtually fool-proof emergency transmitter which automatically sends out SOS signals. It is used by Army Air Forces Flying Crews on ocean-going missions. A hydrogen-filled Neoprene balloon or a collapsible kite supports the antenna at about 300 feet altitude.

IRVINGTON VARNISH & INSULATOR CO.
Irvington, New Jersey, U. S. A.
Plants at Irvington, N. J., and Hamilton, Ontario, Can.
Representatives in 20 Principal Cities

IRVINGTON *Electrical* **INSULATION**

Save
METALS
FOR
PLANES
TANKS
SHIPS
with
KNOX
PORCELAIN
the Complete Line



ECONOMIZE ON TIME
ONE SOURCE OF SUPPLY . . .
ONE ORDER

KNOX . . . CAN SUPPLY ALL
YOUR WIRING NEEDS

WRITE FOR COMPLETE INFORMATION

KNOX PORCELAIN CORP.
KNOXVILLE, TENN., U.S.A.



AN ULTRA-SAFE electrical system is the goal of M. L. "Irish" Levy, electrical engineer for Higgins Industries, Inc., New Orleans, La. Since the average wartime shipyard worker knows little about electricity and its hazards he must be protected.

OVERSIZE CONTACTORS RESTRICTED FURTHER

To prevent unnecessary use of oversize contactors on electric motor controllers, General Conservation Order L-250 has been amended by the War Production Board. The order formerly permitted the use of oversize contactors for any controllers in Appendix A under specified conditions. As amended, L-250 permits the use of oversize contactors under the same specified conditions only for controllers listed in Tables 1 and 4 of the Appendix.

In addition, the same size controller must be used for 380 volt service as for 440 volt service, except that the next larger size may be used where the full load motor current at 380 volts exceeds the rating of the controller.

Interpretation 3, issued with the amendment, states that controllers covered by L-250 include both those assembled with other apparatus and those mounted individually.

CENTRAL MATERIALS RESERVE ESTABLISHED

Beginning with the first quarter of 1944, all allotments of controlled materials for construction and facilities, save to certain specified military, naval and other programs, will be made from a central materials reserve to be established for this purpose by the Requirements Committee and administered by the Facilities Bureau.

Within the reserve to be established, maximum quantities of controlled materials will be earmarked for each claimant agency, including firm allotments for approved programs and a modest allowance for miscellaneous non-programmed requirements. The central reserve will exceed the aggregate earmarked quantities of controlled materials by an amount calculated to satisfy

How to save time by doing more reading

That is a profitable paradox for you. More true today than perhaps ever before. For here in the pages of this publication are packed many helpful ideas . . . considerable useful information. Much of it, in fact, available from no other source.

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Many people have found this a fact . . . not only once, but time and time again. That's significant . . . with time so precious today.

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Good advertising speeds information from those who have it . . . to those who need it.

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Publishing Company, Inc.

330 West 42nd Street
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emergency requirements that might arise during the quarter.

Controlled materials earmarked for a claimant agency will not be transferred without that agency's approval and the Facilities Committee must approve in advance allotments from the non-earmarked portion of the reserve.

The new controls set for the first time an over-all limit on the amount of materials that will be available for construction and facilities. Previously, a claimant agency, once it had been allotted its quarterly share of controlled materials, could apply them as it wished to its approved programs.

Considerable saving of paper work and time in processing applications will result from the new method, WPB officials said.

LIMITATION ORDER ON VISES POSTPONED

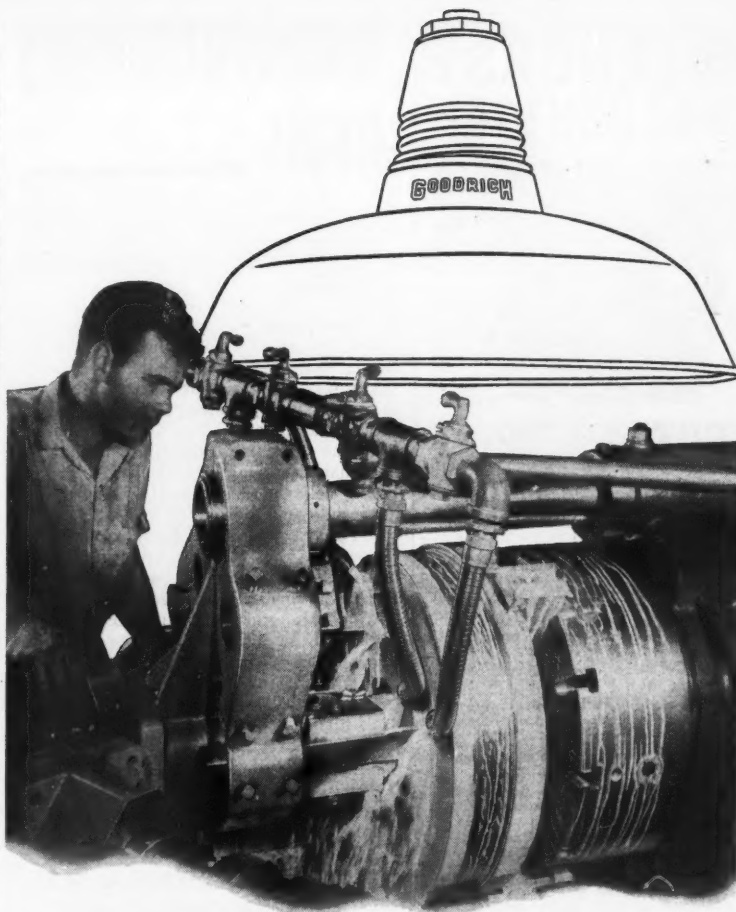
The effective date of Schedule VI of Limitation Order L-216, which was originally issued September 7, and reduced the number of types and sizes of vises which could be manufactured from approximately 165 to about 40, has been postponed until January 1, 1944, by the War Production Board.

Since the schedule was issued, it has been called to the attention of WPB that the manufacture of certain types and sizes of vises needed in the war effort is forbidden. Hence, it was decided to postpone the effective date of the schedule and meanwhile conduct a poll of the vise industry to ascertain what changes should be made in the schedule. All suggestions received will be given consideration. Postponement of the effective date of the schedule pending receipt of these comments will avoid imposition of undue hardship on any manufacturer, the Tools Division said.

The original purpose of issuing Schedule VI was to conserve critical materials and man-hours.



PROSPECTIVE RULES for Code treatment of electric welders were outlined to Western Section, IAEL members by L. W. McCullough, New York City, chairman, Technical Subcommittee on Electric Welding of the Electrical Committee, NFPA.



• **BETTER LIGHT**

• **BETTER SIGHT**

• Better Fight!

No question of it! Light is in the fight! It is ready to help you win production battles.

Make the most of it by using it correctly—to speed up production—to keep workmen more efficient—to eliminate fatigue, cut down spoilage, reduce accidents.

Where skill and precision count, proper illumination is a job for engineering specialists.

Goodrich puts them at your service—with the wide variety of porcelain enameled fixtures that answer every industrial lighting requirement.

Serving essential industries is the number one job of Goodrich Illuminating Engineers. Let them help you make the most of light as a fighting tool. Write us.

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HIGHLITE



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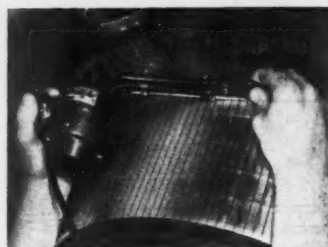


REFLECTO FLOODLIGHT

GOODRICH
ELECTRIC COMPANY
OFFICES IN ALL PRINCIPAL CITIES

GENERAL OFFICES AND FACTORY: 4602 BELLE PLAINE AVENUE, CHICAGO 41, ILL.

HULLHORST UNDERCUTTER



PORTABLE NO. 62

• Here is a light weight—compact—handy—portable mica undercutter ideally suited for industrial maintenance men and motor repair shop crews.

LIGHT WEIGHT—weighs only 4 lbs.

COMPACT—Gets into smaller spaces.

CAPACITY—Undercuts horizontal commutators up to 30" dia.

MOTOR—Light, powerful, ball bearing equipped.

SMALL CUTTER—Allows smooth operation, gets closer to riser—lower cutter cost.

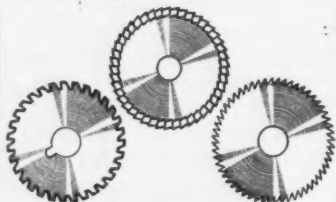
BLOWER—Amples for blowing mica dust away for best visibility.

SIMPLICITY—Fewer parts than most undercutters—no flexible shafts to give trouble.

The price of the No. 62 Undercutter with 110 Volt Universal DC motor or 25-40 75 cycle AC includes carrying case, bar, screw driver and 20 Hullhorst High Speed Steel (1/4") Cutters—4 each of .015", .025", .030", .035" thickness or assorted as you want them. Also furnished with 220 Volt Universal motor at slight increase in price.

HULLHORST Mica Undercutter No. 10

A compact, high production, under-cutting machine, handling armatures up to 6 1/2" in dia. and shafts up to 1 7/8" long. Built specifically for manufacturers and large electrical service shops.



HULLHORST High Speed Steel Commutator Saws

An adequate supply of all important standard sizes in carried in stock. Specify Hullhorst for—faster cutting—longer life—adaptability to all types of Mica Undercutters. In ordering give diameter, hole, thickness and purpose for which intended.

HULLHORST MICRO TOOL CO.
Division of
TOLEDO STANDARD COMMUTATOR CO.
2242 SMEAD AVE.
TOLEDO 6, OHIO

MANUFACTURERS NEWS

WESTINGHOUSE CHANGES

Westinghouse Electric and Manufacturing Company has announced the appointment of C. A. Smith and H. W. Tenney as assistants to Thomas I. Phillips, vice president of the East Pittsburgh Divisions. Mr. Smith will assist in the administration and coordination of manufacturing activities. Mr. Tenney will help coordinate vital wartime engineering activities.

Peter L. Lenz has been named manager of the Middle Atlantic District Manufacturing and Repair Department. He was formerly manager of the Homewood Manufacturing and Repair plant, Pittsburgh, and he will now make his headquarters in Philadelphia.

R. F. Tucker and Adolph Frankel have been appointed as staff assistants to the manager of the Westinghouse Lamp Division, with headquarters at Bloomfield, N. J.

G-E APPOINTMENTS

General Electric Company has appointed T. O. Eaton manager sales, Power Transformer Section at G. E.'s Pittsburgh Works. He became affiliated with



General Electric in 1925 when he joined the Drafting Department at the Company's Schenectady Works. The following year, he entered the Test Course there and in 1939 was transferred to Pittsburgh as a Switchgear Specialist. He remained in that city as a member of the Industrial Sales Department from 1933 to 1938 when he was transferred to Philadelphia. On the first of this year, Mr. Eaton was appointed assistant manager of sales, power transformer section, Pittsfield.

E. D. Monk, Mr. Eaton's predecessor, who has been with the company 34 years, will continue as a member of the Section for consultation and special duties.

Wallace K. Brown, former vice-president in charge of Procurements for the Crocker-Wheeler Electric Manufacturing Company, has been made manager of the New York District sales of the Crocker-Wheeler Division of the Joshua Henry Iron Works office there.

102 engineers and scientists make the

STANDARD HANDBOOK for ELECTRICAL ENGINEERS

dependable and practical for you

Archer E. Knowlton,
Editor-in-Chief
Associate Editor for
Engineering,
Electrical World

7th Edition, 2303
pages, 6x9, 1700 illustrations, 600 tables,
\$8.00

HERE is the great standard reference work of all in the electrical engineering profession or whose work in industry or engineering touches on this field. Its 2303 pages present a handy - reference compilation of practical, usable data from all fields of electrical engineering practice, plus the most frequently required fundamental theory, units, and systems of measurement, made dependable by the work of more than 100 engineers, scientists, teachers, and other authorities.

Thousands of useful facts in these 26 BIG SECTIONS

Units and Conversion Factors
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Properties of Materials
Circuit Elements
Transformers, Regulators and Reactors
Alternating - current Generators and Motors
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Rectifiers and Converters
Prime Movers
Power Plant Economics
Power System Electrical Equipment
Power Transmission

Power Distribution
Wiring Design—Commercial and Industrial Buildings
Illumination
Industrial Power Applications
Electric Heating and Welding
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330 W. 42nd St., New York 36, N. Y.
Send me the Standard Handbook for Electrical Engineers, 7th Edition, for 10 days' examination on approval. In 10 days I will send \$8.00, plus few cents postage, or return book postpaid. (We pay postage if you remit with order.)

Name
Address
City and State
Position
Company EC 12-48

WESTINGHOUSE SUPPLY APPOINTMENT

Westinghouse Electric Supply Company, New York, announces the appointment of M. P. Nickerson as general apparatus and supplies manager. He will have complete responsibility for the development, coordination and promotion of apparatus business nationally.



NICKERSON

In 1925, he joined Wesco Boston as Stores Manager. Five years later he was made assistant sales manager in the Cleveland district. Two years later, in 1932, he was transferred to the Eastern District, New York, as assistant to the District manager and in 1937 was moved to headquarters and put in charge of syndicate business for the company.

COPPERWELD ORGANIZATION CHANGES

In recent organizational changes, the Copperweld Steel Company, Glassport, Pa., announced the appointment of Wm. W. Ege as general manager of sales succeeding W. J. McIlvane, now executive vice-president. Mr. Ege was formerly Western sales manager with headquarters at Chicago.



WM. W. EGE

Paul Van Wagner, at present vice-president in charge of export sales, is succeeded by Henry Oberle, who assumed the duties of Eastern sales manager. Prior to his recent appointment, Mr. Oberle was with the Queensborough Gas and Electric Company.

P.A. Terrell was made assistant to the executive vice-president in Glassport.

Erich G. Elg was named to the position of Western sales manager, succeeding Mr. Ege.

CUTLER-HAMMER APPOINTMENTS

Cutler-Hammer, Inc. of Milwaukee, Wis., has announced the appointment of W. E. Addicks as manager of the New York District Office. Prior to this appointment Mr. Addicks was in charge of the Boston Sales Office.

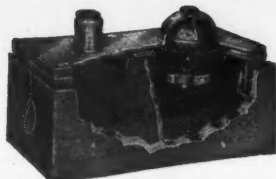
C. V. Topliffe has been made manager of the Boston District Office, succeeding Mr. Addicks.

United States Rubber Company, New York, announces the appointment of Harold J. MacDonald as manager, jobbing sales, and Howard F. Johnson as manager of branch sales with offices at 1230 Sixth Avenue, New York.

Sylvania Electric Products, Inc. announces the appointment of John P. Waters as advertising manager of the Lighting Division. Mr. Waters was

Latrobe PRODUCTS

★ FLOOR BOXES ★ WIRING SPECIALTIES ★



NO. 252-R TWO GANG BOX

Two gang adjustable floor box with No. 208 receptacle in one section. One cover plate with 1/2" flush brass plug and the other cover with 2" flush brass plug.

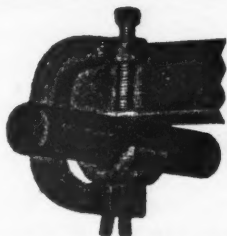


NO. 110 LATROBE WATERTIGHT BOX

Quickly installed—just attach wires and fasten on cover plate. No small screws, receptacle straps or filler plates to bother with.

Safe, Economical, Easy to Install

Latrobe Floor Boxes and wiring specialties are designed for commercial, industrial and residential use. They may be quickly and easily installed—real time-savers—and may be depended upon for long trouble-free service. Write today for complete catalog and price list of Latrobe Products.



NO. 470 "BULL DOG" PIPE OR CONDUIT HANGER

Made of high grade malleable iron—Strong and sure. Will hang pipe 1/2", 3/4" or 1" to 3/8" steel beam.



BULL DOG
Insulator Supports
made of malleable iron.

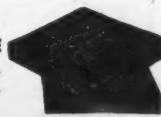


NO. 280 NOZZLE

In No. 200 Cover Plate Ten Amp. 250 Volt receptacle in Brass Housing, mounted on 1/2 in. brass pipe extension 3 in. long. Furnished with longer pipe extension if desired.

KEYSTONE FISH WIRE

Flat steel wire highly tempered.



FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

**"We can change
any fitting
without dis-
turbng conduit—**



**—because we
use KONDU!"**

You can lift any box out of the line and put in another, without disturbing conduit—but only if you're using Kondu. Or if necessary, you can install a conduit line before the fittings are delivered. Every Kondu box is a union.

You can attach either Thin-Wall or Thick-Wall conduit at ANY outlet of ANY Kondu fitting—making either a Threadless or Threaded connection. Just slip out one bushing, and put another one in. No extra parts are needed.

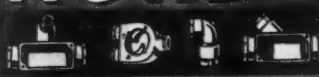
Vibration-proof, Kondu holds permanently tight, in perfect alignment. Quickest to install. Practically unbreakable—100% re-usable.

Write for the Kondu Catalog.

KONDU CORPORATION

Erie, Pa.

KONDU



**The Threadless Fitting Line
of Unequaled Variety**



formerly assistant director of advertising and promotion at Armstrong Cork Company.

Mr. Waters takes a position vacated by B. K. Wickstrum, who has accepted a special sales assignment reporting directly to Robert H. Bishop, general sales manager of the Lighting Division.

BullDog Electric Products Co., Detroit, Michigan, announces the appointment of Horace E. Fritschle as midwest division manager of the company. Under his new appointment, he will supervise and direct the activities of the BullDog district offices in Chicago, Milwaukee, St. Paul, St. Louis and Kansas City. Mr. Fritschle has been Chicago district manager since 1938 and will continue to make his headquarters at the Chicago office.

Republic Steel Corporation, Cleveland, announces the appointment of Harvey A. Craig as district sales manager in the Los Angeles district. Arthur C. Geldner will be assistant district sales manager. For many years Mr. Craig was vice president of Rheem Manufacturing Company, Richmond, Calif.

Corrosion and Electrolysis

[FROM PAGE 35]

power losses, rail and fastening deterioration and protection of its positive and negative underground power cables.

In general, electrolysis conditions due to stray railway currents can be minimized or corrected by adjustment of the loads and loading periods of the various railway substations; by the use of a well designed return system embracing perhaps insulated feeders between various rail points and the negative bus; use of resistance grids in some feeders and of insulated return feeders between the various underground structures such as water pipes, electric cable sheaths, gas pipes, telephone and telegraph cable sheaths, etc., and the negative bus. The latter feeders to the underground structures are generally called "drainage feeders" to distinguish them from the "negative feeders" to the rails.

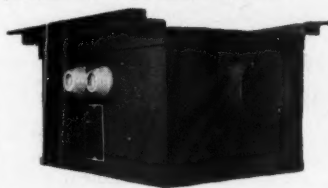
Sometimes non-reversing relays are placed in the "drainage circuits" to prevent reversals of current from the rails during substation light load and shut down periods. All of these circuits usually carry relatively large currents at relatively low voltages since the entire railway substation load must pass through these feeders. A typical substation may have an average off peak load of 1,000 amperes, 750 amperes of which

FOR MODERN EFFICIENT LIGHTING



ACME FLUORESCENT LAMP BALLASTS

Now available in designs and sizes to meet W.P.B. regulations. Write for Bulletin 157-157A.



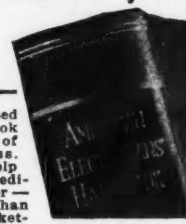
COLD CATHODE LIGHTING TRANSFORMERS

Familiarize yourself now with this new form of lighting. Write for Bulletin 162.

THE ACME ELECTRIC & MFG. CO.
CUBA, N. Y. CLYDE, N. Y.

HOW TO handle every type of electrical job

**—quickly
—accurately**



Thousands have used this famous handbook as a working guide of everyday usefulness. NOW it is ready to help you too, in a big 5th edition—400 pages larger—up-to-date—more than ever the one great pocket-book of practical electricity for you.

1600 pages, 1177 illustrations, \$5.

Croft's AMERICAN ELECTRICIANS' HANDBOOK

Revised by C. C. Carr, Pratt Institute

This book is packed from cover to cover with the facts every man doing electrical work needs to have constantly at hand—from fundamentals of electricity to remedies for electrical equipment troubles. Helps you install commercial electrical apparatus and materials intelligently, operate electrical equipment efficiently, and maintain it at high operating efficiency.

10 DAYS' FREE EXAMINATION

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Send me Croft's American Electricians' Handbook for 10 days' examination on approval. In 10 days I will send \$5.00 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

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may be returned directly from the rails and 250 amperes of which may be returned from the underground pipes and cable sheaths over the "drainage feeders." The overall drop in the return circuits from the street car wheels to the negative bus may be 20-volts.

What is an "objectionable current?" Any direct current no matter how small is objectionable when it discharges from the surface of a pipe or cable to surrounding earth. A few micro-amperes discharging from a small hole in a pipe coating or in a jute covering on a lead sheathed cable may cause failure of such a pipe or cable within a year. On the other hand, hundreds of amperes flowing along a pipe or cable run may not be objectionable, in fact it may be desirable.

It has been definitely proven that direct current in moderate amounts if "collecting" on the surface of a metallic structure will not only in itself be harmless but will actually cause the counteracting of natural galvanic action, thus protecting a pipe or cable from natural corrosive action. While stray currents from street railways years ago were regarded as a nuisance, later it was recognized that these same currents were affording underground pipes and cables untold protection from natural corrosion. It was further discovered that to protect a pipe or cable from natural corrosion when "stray currents" were not available, it was possible to artificially generate "stray current" by use of low voltage generator connected so that the pipe or cable to be protected was made negative or cathodic to the surrounding earth. This process is called "Cathodic Protection." If such a system is not well designed, maintained and operated, it is possible for the currents involved to damage neighboring metallic structures and the structure intended to be protected. "Cathodic Protection," while a very useful and proven electrical process, should not be attempted by anyone not expert in its fundamentals.

Electrolysis from Welding

Stray current electrolysis conditions can be caused by industrial electric welding operations. If the positive and negative connections are made directly onto the piece of metal being welded, there is little likelihood of stray welding currents if the generator windings are insulated from ground. However, if one leg of a welding generator is "grounded" near the generator, even with a sizable return wire to the work, there may be appreciable "stray currents" between the work and the generator "ground" caused by the voltage drop in the cable.

[Continued on page 106]



Look at the Features

1. Small in diameter — Saves space.
2. Superaging—Long life, no oxidation.
3. Easy pulling — Hard, smooth finish.
4. Heat resistant — Rated 60 deg. C.
5. Free stripping — Speeds splicing and soldering
6. High dielectric strength—720 volts per mil, test result
7. Flame proof — Will not support combustion
8. Insulation — Tensile strength of 2000 lb. per sq. in., test result
9. Many colors—Same range as Type R wires
10. Oilproof — Unaffected by oils, water, acids, alkalis
11. Attractive — Retain fine appearance
12. Self-protecting—No braids necessary

FLAMENOL Building Wire is not a new and untried product. It was developed before the war and has been used in all sorts of buildings. What is more, wires with Flamenol thermo-plastic insulation have been used for a much longer time—switchboard wire, wire for signal circuits, machine tools, etc. It is approved by the Underwriters'.

Flamenol Building Wire is available now in sizes 14 to 1,000,000 CM. (Resins are permitted for electrical conductor insulation wherever copper is allocated.) Use this wire for the war-purpose jobs you are handling. It is easy to use and will give long service.

For further information see the nearest G-E Merchandise Distributor or write to Section W1231-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.

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athon — Master — Delco —
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inghouse — Allen Bradley —
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WINDING MATERIALS
& REPAIR SHOP SUPPLIES

Write for Catalogue

READING ELECTRIC COMPANY, INC.
200 William St. New York, N. Y.

Corrosion and Electrolysis

[FROM PAGE 105]

If the unit is "grounded" at the generator and no direct return is provided between the work and the generator, as may be the case with well grounded ships or barges lying in water, there is a possibility the entire welding load may become "stray earth currents" causing corrosion damage to underground pipes, cables, tanks, etc. (See Fig. 3.) Direct grounding of welding generator circuits to the metal to be welded, and by this is meant the return load leg and not the frame of the machine, would minimize or eliminate stray currents.

It is reported that some industrial plants are constructing their paved floors with reinforcing mesh close to the surface with some strands exposed to permit a metal object to be "grounded" for welding purposes by simply placing it on the floor. It is obvious that such a scheme will create a multiplicity of stray current situations on pipes, cables, tanks, building foundations and on the reinforcing itself. Some of this undoubtedly will be detrimental and require careful study, before the correct solution is found. (See Fig. 4.)

From an electrolysis and corrosion standpoint, there are vast differences between "grounds." It is often desirable to provide insulation between various members of grounded circuits. For example: street railway rails should never be grounded to electric conduits, water pipes, gas pipes, cable sheaths, tanks or other underground structures in car barns. Yet the rails as well as the other structures are generally considered as grounds. It is also desirable, in some cases, to insulate the sheaths of cables from a general grounding scheme and provide a separate ground system for the sheaths based on good electrolysis and corrosion practice. This is particularly important on high tension underground cables employing types of insulation that are easily broken down by moisture whenever the sheath is penetrated by corrosion.



TIME SWITCHES

TRIPLE POLE
DOUBLE POLE
SINGLE POLE

All three types can be furnished with capacities ranging from 20 TO 200 AMPERES PER POLE, listing from \$16.50 up. Ten ampere Time Switches from \$3.95 up.

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INTERVAL TIMERS, or PROCESS TIMERS, are furnished in two types. One is reset by hand (manual); other resets itself, automatically. Both types can be provided for practically any cycle of time, fully adjustable from zero to maximum period. SYNCHRONOUS, SELF-STARTING MOTORS.

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Used extensively for starting and stopping industrial work; school class periods; for municipal time signals, etc. Up to six signal periods, permanently set at factory with Sunday & Holiday Cutout and Manual Control, at a list price of only \$35.

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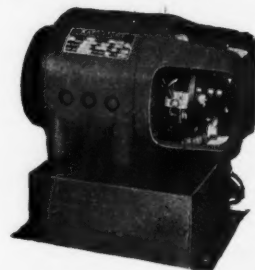
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MANKATO, MINNESOTA

110-Volts A. C. from Direct Current

On the Fighting Front On the Home Front

with KATOLIGHT ROTARY KONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.



KATO ROTARY KONVERTER, 225 Watts

Good deliveries on rotary converters 350 through 1500 watts. Quiet in operation. Can be furnished with special flooring equipment for sensitive radio work.

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At present Kato's entire production must be directed to furnishing converters on high priority orders. Write us if you need this kind of equipment for war orders.

Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.

628 N. Front St., Mankato, Minnesota

Practical Methods

[FROM PAGE 42]

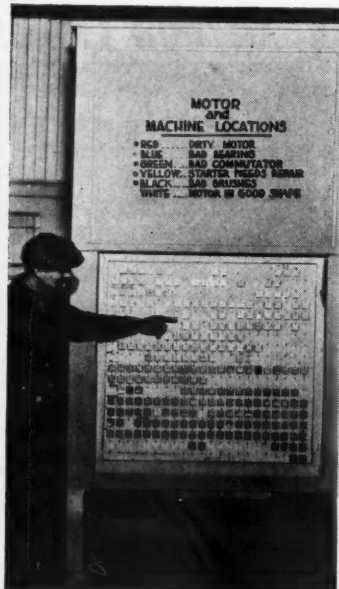
In order to get a nice channeling job on the dropping cables, long bolts were placed crosswise at the top of the trough (or at the bottom of the pull-box). Each bolt carries a number of insulators using short lengths of pipe for spacers. As the cables emerge from the end of the conduit, they are carried over the proper insulator, dropped through the trough, threaded through the correct holes in the slate roof at the bottom and taken (three to five feet) to the switch terminals.

MOTOR BOARD PAGES MAINTENANCE

INDUSTRIAL

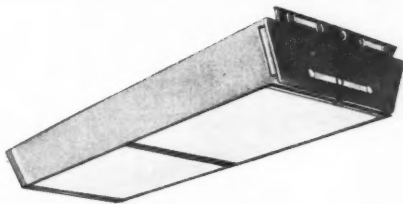
Probably there is no one who is more cognizant of the economic and practical advantages of systematic electrical maintenance than the manufacturers of such equipment. Consequently such plants have well organized electrical maintenance departments that are always on the alert for ideas that will simplify maintenance and increase the efficiency of the department.

A unique method of constantly keeping motor conditions before the eyes of



CENTRALLY RECORDED on this "Motor Board" are the conditions of each electric motor in this manufacturing plant. Color coded pins under metal tags representing each motor indicate condition of equipment at last maintenance check-up. One board represents a complete shop.

KEEP AHEAD WITH LEADER!



URC Research Luminaires are finished in rich silver-gray enamel with high reflecting chip proof white enamel throughout. Knockouts are on top for stem mounting. Provisions are made for continuous mounting in the end plates which lock raceway sections together with nipples and locknuts. Single and double type track units furnished of No. 18 USSG steel. Bottom panels of double prismatic ribbed glass—side panels double strength ribbed glass. Takes four 40-watt 48-inch tubes, latest type approved Tulamp ballasts and easy replaceable starter switches. Operates on 110-125 volt, 60 cycle, A.C.



U R C Research

LUMINAIRES



ZEPHYRLITE INDUSTRIAL UNITS

ZEPHYRLITE Industrial Unit 340 is engineered to meet the requirements for high level illumination where greater foot candle intensity is required. Channel finished in gray backed enamel as is top surface. Reflector double coated baked enamel, reflecting surface white. Reflecting factor app. 89%—60 cycle, 120 volt, A.C. All units equipped with two side hangers for chain or rod suspension. Knockout for conduit or pipe suspension. Knockout in channel on 24" and 36" centers. Side top knockouts for switch installation. Takes three 40-watt T-12 fluorescent lamps. Shipping weight 29 lbs.

Our modernly-equipped factory and competent staff of illuminating engineers assure excellence of product and strict conformity to specifications. Let us send descriptive bulletins which give specifications, details of manufacture, and illustrations.

Engineering Facilities in all principal cities

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● Today's particular and intensive manufacturing requires specialized lighting — engineered to the present swift tempo. LEADER offers fluorescent lighting units to meet these needs . . . units that help Jobbers keep ahead of the times — they open up untold and unlimited opportunities for good lighting business. Fluorescent lighting is the illumination of the future and this complete line by LEADER presents a revenue source that is barely tapped.

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An Alternate and IMPROVEMENT for solder-and-tape wire joints. IDEAL "Wire-Nuts" (solderless, tapeless wire connectors) contain no copper or copper alloys—no tin or rubber as used with solder-and-tape joints. Because "Wire-Nuts" do not require critical materials, they are immediately available. Easy to use; strip wires—screw on—that's all!

**Better Electrically—
Stronger Mechanically**

"Wire-Nuts" powerful grip on wires prevents shorts, grounds and corrosion—and they withstand several times greater pull than the best soldered joint.

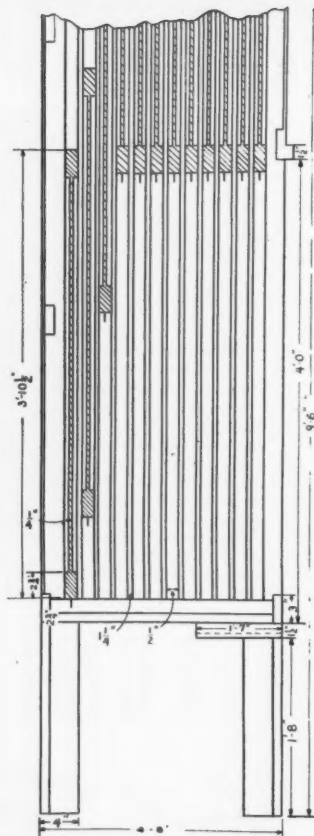
Fully Approved.
Listed by Underwriters' Laboratories, Inc. Sizes for connecting all combinations from two No. 18 to three No. 10 wires.



If your Electrical Jobber hasn't a supply, write or wire, mentioning Jobber's name.

IDEAL Sycamore
• IDEAL COMMUTATOR DRESSER CO. •

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Sales Offices in all Principal Cities



CONSTRUCTION DETAILS show how board and cabinet are built. The number of boards in the cabinet depend upon the number of shops, or departments in the plant. Boards can be locked in upper position and lowered for observation or entering latest maintenance reports.

the maintenance crew was recently devised and employed by the La Porte, Indiana, Works of the Allis-Chalmers Mfg. Company. A simple, practical "Motor Board" permits a maintenance man to ascertain the condition of every electric motor in the entire plant in a few minutes.

The board solved the problem of centrally recording the results of periodic motor check-ups—a need that resulted from stepping up routine maintenance to a wartime tempo. A cabinet was designed to hold a number of boards approximately four feet square and arranged one in front of the other. Divided into an upper and lower half, the cabinet recesses the boards in the upper half while those below are exposed for observation. The boards can be raised from the bottom half and locked in place in this upper "hood."

Key to the system of maintaining a constant check on the plant's motors are small metal tags, each of which is stamped with the number of a motor in the shop. Each board represents a

**TOPS
IN
TIME
SWITCH
QUALITY**

for only \$13.00 LIST...



The Paragon 300 Series includes ALL the essential features of truly top quality time switches... yet the list price is only \$13.00. Some of the features are: only 2 exposed gears, all others operate in a sealed oil-filled chamber; slow speed motor; sturdy clock train; snap-action switch; simple hand trip; attractive modern case; 2000% more dial power than required. Satisfactory service, workmanship and material guaranteed. Send for complete bulletin.

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BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905



**HEAVY DUTY
Carbon Lamps**

FOR INDUSTRIAL USE

• Recommended for use where Long Life is essential, where Vibration is excessive, where Inaccessibility of lighting fixtures makes Replacement Difficult, where a Pilot Light is needed.

Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.



**NORTH AMERICAN
ELECTRIC LAMP CO.**

1044 Tyler Street St. Louis 6, Missouri

shop, and the position of the hook on which each tag hangs represents the position of that motor in the shop. If a motor should be moved to another location, its tag is simply transferred from one hook to another, making the system unusually flexible.

As the motors are inspected, or reports on their condition are received from the shops, these specific conditions are indicated on the "Motor Board" with colored pins placed under the tags. The following color code is used:

Red Dirty Motor
Blue Bad Bearing
Green Bad Commutator
Yellow Starter Needs Repair
Black Bad Brushes
White Motor in Good Shape

This code, indicating the condition each colored pin represents, is plainly shown on the panel covering the upper half of the cabinet. As quickly as repairs can be made or precautions taken, pins are removed or changed.

In operation, the plant's maintenance department reports the board is proving highly successful, especially in preventing undesirable motor conditions from reaching advanced stages requiring more serious repairs—and a possible shutdown. The responsibility of keeping the board "up-to-date" falls on the shoulders of each member of the maintenance crew who must report his periodic check-ups on it. This system gives maintenance headquarters a visual picture of motor conditions throughout the entire plant. A board with colored pins predominating (other than white) stands as a constant reminder that "immediate action" is necessary.

FINGER-TIP MOTOR CONTROL

—WIRING

Considerable time is saved on setting-up operations on a gear shaper at the Tool Steel Gear and Pinion Company, Cincinnati, by providing the operator with finger-tip control of the machine motor. Instead of being conventionally mounted in a stationary position, the pushbutton on this machine is at the end of a flexible extension cord.

The extension cord, terminating at the magnetic contactor of the combination motor starter, is of sufficient length to permit the operator to have the pushbutton in his hand regardless of the part of the machine at which he may be working. Since considerable "inching" of the motor is necessary when setting up the work in the machine, the operator must be able to control the motor at will. With the control button in his

ELECTRICITY for ANY JOB Anywhere

This is
Model
W2C

ONAN GASOLINE DRIVEN ELECTRIC GENERATING PLANTS provide power and light wherever electricity is not otherwise available and for emergency service.

Thousands of these reliable, sturdy Plants are doing war winning work on all fighting fronts.

Sizes from 350 to 35,000 watts. 50 to 800 cycles, 110 to 660 volts, A.C.—6 to 4000 volts, D.C. Also A.C.-D.C. output models available.

Your inquiry regarding present or past war needs will receive prompt attention.

D. W. ONAN & SONS
2084 Royalston Ave.
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Awarded to each of ONAN's four manufacturing plants.



ONAN
ELECTRIC PLANTS

Trailing Cables FOR Vital WAR Work

TIREX - rubber sheathed - cables were designed for hard, rough work. They still have remarkable wearing qualities and abrasion resistance and can be depended upon for continuous, dependable performance but, for the duration of the war, they meet restrictions governing the use of rubber, copper and other scarce materials.

It is important, now more than ever before, to get maximum service from trailing cables upon which portable or mobile electrical equipment depends for current. New cables are hard to get and those already in service must be used until they are completely worn out. To this end we make four suggestions.

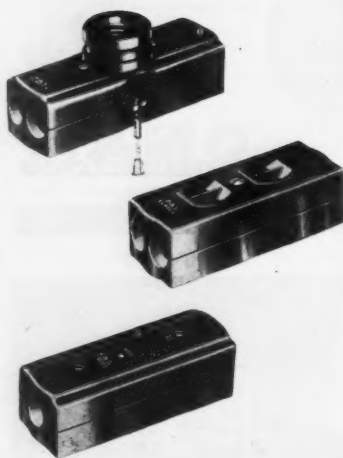
1. As far as possible use the proper size and type of cable for the work to be done.
2. Inspect cables frequently and regularly to discover conditions that may cause trouble.
3. Provide extra protection or change location where exposure is hazardous.
4. Make repairs promptly when needed.

If you must have new cables for vital war work we shall be pleased to do all we can, consistent with conservation restrictions, to help you get what you need.

Simplex WIRES and CABLES
Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

Conserve
CRITICAL
MATERIALS

★
**USE P&S
PORCELAIN
WIRING DEVICES**



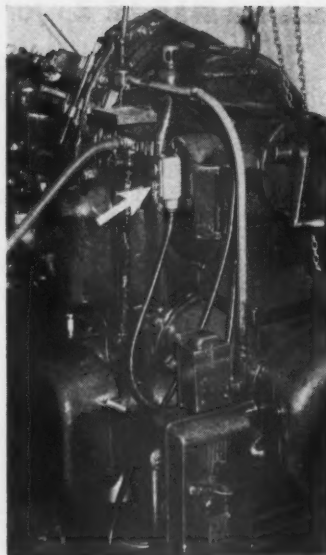
There is still a definite need to conserve every ounce of critical material—and there is electrical wiring that must be done.

P&S Porcelain Wiring Devices—backed by over fifty years manufacturing experience—will do the job and do it well. Use Porcelain Sockets and Receptacles. Use P&S Surfex, the surface wiring device line made of porcelain.

SOLD THROUGH
ELECTRICAL WHOLESALERS



PASS & SEYMOUR, INC.
SYRACUSE 9, N. Y.



PORTABLE CONTROL button (arrow) on this gear shaper provides the operator with finger-tip control over the machine during setting-up operations. After machine is running, button is hung on stationary hook over the starter.

hand, the worker need not fumble around for it or repeatedly hop to one end of the machine each time he desires to move the work slightly.

One end of the control button fitting is equipped with an eye. When the work has been properly set up and the machine is in operation, the control button can then be fastened to a protruding hook conveniently mounted to the unit near the motor starter.



VARIOUS SERVICES in the post-line buildings of New York City's Aluminum Company are mounted in banks at accessible points. Note the variety of equipment. On the cover of the wiring trough is painted the circuit, type and voltage of each service switch such as "Cranes, 220 volt, d.c."



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TWO-PIECE GLASSTEEL DIFFUSER

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is hard
WORK**



**BUT ZENITH
DOESN'T MIND
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ZENITH

Magnetic Contactor

Coil wound to keep cool on continuous service. Electrically held. Full floating armature—minimum hum. For severest duty. Withstands surge of type C lamps. Used as motor starter, blackout switches, emergency controls, X-Ray, etc. Used in war production plants. 30 to 400 amps, A.C. to D.C.



Full Line of Control Equipment shown in Zenith Catalog. Send for it.

Transfer Switches, Timers, Program Clocks, etc. We make controls for special jobs. Wire or write.

ZENITH ELECTRIC CO.
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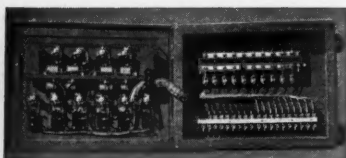
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do it!

The South's largest general electrical contractor offers you the experience gained from millions of dollars worth of successfully completed contracts for Army, Navy and civilian projects of all kinds including structural work and public utilities distribution systems.

Full equipment and engineering staff available to service any contract, regardless of size.

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Marine Electrical Specialties

All types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army and Navy specifications. Full engineering personnel and equipment for manufacture of special electrical items in addition to all standard articles.

Write for information.

**Jacksonville Metal
Manufacturing
Company**

JACKSONVILLE, FLORIDA

This scheme can readily be adapted to almost any type of machine where flexible control of the motor would materially speed up the setting-up operation and hence save many otherwise unproductive man-hours.

TANDEM OPERATION OF LARGE DRIVES

INDUSTRIAL

When a smaller drive becomes overloaded it is generally replaced by a larger single unit that can handle the load. However as the rating increases beyond a certain critical size, it becomes a question of economics. Can the old drive and control panel be utilized elsewhere or must it be scrapped if replaced by a larger single unit drive? Or is tandem operation the answer?

Reynolds Metals Company of Richmond, Va., manufacturers of aluminum foil, have felt the pressure of war contracts as much as any industry in the country. Facilities have been greatly expanded and many processes have been stepped-up in varying degrees through recent developments of production machinery. Speed-ups have, of course, made increased demands on plant drives and electrical distribution facilities.

The main aluminum foil rolling mill is an outstanding example. Aluminum ingots are taken from the furnaces at about 900° F and placed on the roller table. Each ingot then gets from nine to eleven passes before it is moved on down to the next mill. The mills are composed of three rolls. The main drive is geared to the center roll which is in turn geared to the upper and lower rolls. After the ingot passes through the center and lower rolls, the tables on either side are raised and the ingot is passed back through the center and upper rolls. After each pass, the ingot must be centered-up for the succeeding pass, and



EXPLOSION-PROOF wiring is the specialty of Walter J. Barnes, Walter J. Barnes Electric Co., New Orleans, seen here discussing a job with I. G. Marks (right), secretary of New Orleans chapter NECA.

I bought more than a
PIPE BENDER!

My Porto-Power
licks maintenance jobs, too!



Blackhawk Porto-Power Pipe Benders would still be the choice of many experienced contractors and electricians — even if the Blackhawk Bender could only bend pipe. But, Man! — bending pipe (up to 4"), and doing it well, is only part of the story!

Simple attachments can be used with the Porto-Power Hydraulic Unit—to handle tough maintenance jobs, construction work and change-overs. Write for the V-43 catalog or call your Blackhawk Distributor for more details on how Blackhawk Benders can do all this extra work.



**PULL DRIVE PULLEYS
AND GEARS** —
Smoothly, safely. No
crow bars! No sledging!



LIFT MACHINERY —
Raise a 10-ton load
from a low of 3½" to
an 8½" height.



**BUILD YOUR OWN
PRESS** — Free blue-
prints! Use the powerful
hydraulic unit furnished
in the pipe bender.



**A JACK FOR ANY
SPAN — ANY ANGLE**
— Your Blackhawk
power unit is the most
refined hydraulic jack
available today!

BLACKHAWK

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through a
PILE
of Catalogs?



Find the Fitting you need—
quickly—in the **COMPLETE** line

If you have a Penn-Union Catalog, you can instantly find practically every good type of conductor fitting. These few can only suggest the variety:



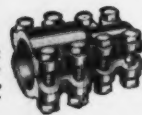
Universal Clamps to take a large range of conductor sizes; with 1, 2, 3, 4 or more bolts.

L-M Elbows, with compression units giving a dependable grip on both conductors. Also Straight Connectors and Tees with same contact units.



Bus Bar Clamps for installation without drilling bus. Single and multiple. Also bus supports — various types.

Clamp Type Straight Connectors and Reducers, Elbows, Tees, Terminals, Stud Connectors, etc.



Jack-Knife connectors for simple and easy disconnection of motor leads, etc. Spring action — self locking.

Vi-Tite Terminals for quick installation and easy taping. Also sleeve type terminals, screw type, shrink fit, etc. etc.



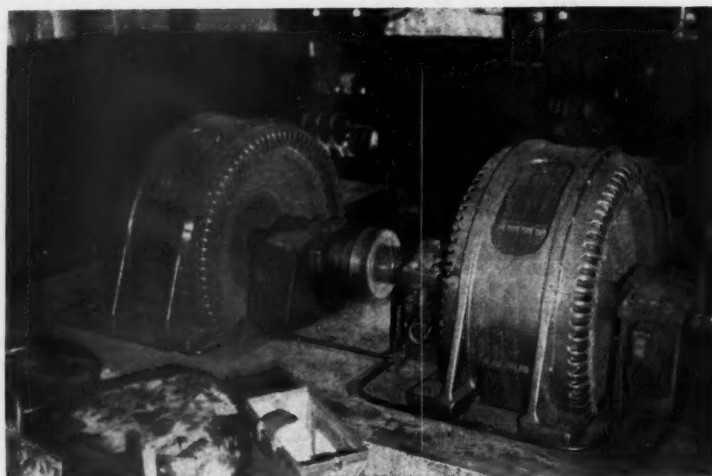
Splicing Sleeves, Figure 8 and Oval, seamless tubing—also split tinned sleeves. High conductivity copper; close dimensions.

Preferred by utilities, industrials, electrical manufacturers, contractors — because they have found that "Penn-Union" on a fitting is their best guarantee of Dependability.

**PENN-UNION
ELECTRIC CORPORATION
ERIE, PA.** Sold by Leading Jobbers

PENN-UNION

Conductor Fittings



SYNCHRONOUS MOTORS coupled in tandem to carry the added load as developments in mill operation increased mill capacity.

the rolls must be screwed-down to a predetermined value.

As the ingot hits the rolls and for the duration of each pass, the actual load on the driving motor is considerably more than its rated capacity of 400 hp. However, in the past, because of the comparatively long interval of no-load during which time the ingot is centered and the rolls are screwed-down, the motor never heated beyond the normal rated degree rise of continuous loading.

Reynolds engineers however, under the pressure of increased war demands, developed automatic guides which keep the ingot centered at all times so that an immediate repass is possible. Along with this, a faster screw-down of rolls was developed so that now the required nine or eleven passes are accomplished in considerably less time.

The result was increased production, but motor heating also increased. From tests and calculations it was decided to use tandem operation. To do this several precautions had to be taken. First of all, an identical motor, with identical characteristics had to be ordered from

the manufacturer of the original machine. This specification was necessary to prevent one or the other from hogging the load.

The rotor of the new motor was specified with a double shaft-extension but with a heavier drive-end shaft so that it could be interchanged with the old rotor, since the old stator was to remain in its original position, close to the load. The old rotor was then placed in the new stator and both rotors were rigidly coupled. The new rating is now 800 hp. tandem operated three phase, 440 volts, synchronous drive. The new control board has been inter-locked through a time delay so that after the first motor (which starts as an induction motor on reduced voltage) is synchronized at full voltage, the second motor (which is now running at synchronous speed, being driven by the first motor) is merely synchronized by applying full voltage and field without the intermediate step of reduced voltage start. The starting is completely automatic from the time the pushbutton makes contact until both are fully synchronized.



IN NEW LOCATION in Richmond, Va., Electrical Equipment Company, motor repair shop and industrial equipment suppliers and jobbers have acquired more space for bigger and better operations. Left to right are H. I. Lamb, asst. treas.; T. T. Thomas, treas. and Richmond shop manager; H. E. Wood, v. pres. and Richmond shop supt.

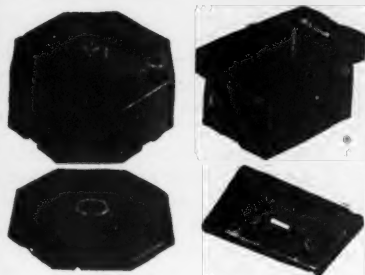
ILLINOIS

Completely Insulated
ALL PORCELAIN
WIRING SYSTEMS

Save Critical Materials

Save Installation Time

Cut Maintenance



★ An ILLINOIS Porcelain System enables you to do an outstanding modern wiring job—you are afforded every advantage in making easier, safer, more convenient, and efficient layouts—you can guarantee these porcelain systems for longest service life, for safety, and for greatest all round satisfaction. Porcelain does not rust or corrode. It is a logical wiring material because it conserves steel, zinc, copper, rubber. Grounding is unnecessary when you use this system. Clamps are not required for porcelain boxes. When you sell your next wiring, sell an ALL Porcelain System.



ILLINOIS
ELECTRIC PORCELAIN
COMPANY
Macomb, Illinois

Motor Stops

[FROM PAGE 47]

METAL RING HOLDS COIL ENDS

A bright idea by W. M. McCord, a young workman on the Remy armature line, Delco-Remy Division, General Motors, has saved 63 man-hours per month, which he and two other opera-



SMALL METAL RING designed by this war worker holds leads in place while commutator connections are made.

tors on the line each can devote to turning out more armatures.

The idea, which brought Mr. McCord an award of \$110.75 in War Bonds and Stamps; incorporates the use of a simple little metal ring which he designed to hold wire leads in position on armatures while commutator connections are being made. The former method of using rubber bands was inefficient and lost considerable time. The bands weren't strong enough to hold the leads securely in position and they frequently broke. Now this trouble is eliminated.

The idea has "paid off" in this production set-up and will prove useful in all shops where numerous armatures of identical size are repaired or assembled.



MOTOR EXPERT George A. Koepp, Koepp Electric Motor Company, Manitowoc, Wisconsin, is the lone service operator in three Wisconsin counties.



*Fitted to
the job ...*

● Yes sir, that's the main idea behind Aerovox motor-starting capacitors. And here's the story in a nut-shell:

1. First of all, there are both universal types (where feasible) for mini-mized stock and greater convenience, and exact-duplicate types (where necessary for precise matching of discarded capacitors).
2. There are up-to-the-minute Aerovox listings of all motors, indicating at a glance what type replacement capacitors to use. That sort of practical information insures the right capacitor for your job.
3. Your local Aerovox jobber carries a stock of motor-starting capacitors to meet your requirements promptly and satisfactorily for profitable servicing.

● See Our Jobber . . .

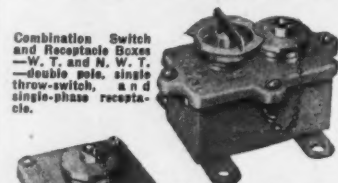
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INDIVIDUALLY TESTED

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Combination Switch and Receptacle Boxes—W. T. and N. W. T.—double pole, single throw-switch, and single-phase receptacle.



Single, Double, and Triple Receptacle Boxes—W. T. and N. W. T.—single phase.



Branch Boxes—W. T. and N. W. T.—have no fuses and are used to connect branch circuits. Branch Junction Boxes are fusible.



AUSTIN Marine Products, some of which are shown here, are made to the highest engineering standards, carefully inspected and packed, and fully approved by the U. S. Navy. Send for Marine Catalog No. 9-B-2 for complete details on the AUSTIN line.

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HIGH TENSION
DETECTOR



SAFETY RULES call for that EXTRA precaution and additional RECHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages... prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.

Call-
Out
Shows
Inside
View

Model A
3-5
handles

Model B
6-8
handles
extension

TEST-O-LITE

Tests Everything Electrical
from 100 to 550 Volts



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VARIOUS NEW MODELS
AND RANGES

WRITE FOR BULLETIN No. 430 E

CHANGE OF ADDRESS

MCGRAW-HILL PUBLISHING COMPANY
330 West 42nd Street, New York, 18, N. Y.

Director of Circulation:
Please change my address on Electrical Contracting

From

To

Signed

Field Coils

[FROM PAGE 33]

tables. Sketches show the section of a frame with the observer facing the front or commutator end. Note the arrows used to indicate direction of armature rotation.

Main and Commutating Poles on Vertical Center Line

Where the basic main south pole is located on the vertical center line of the frame (as in the preceding article) the polarity of the commutating pole A is north or south as the case may be. For clockwise rotation in a motor, the tables show that pole A should be a north pole. Also, for a generator and clockwise rotation, the tables show that pole A should be of south polarity. The data in the figures and tables can be used to determine the polarity of all the main and commutating poles for motors and generators and for the desired armature rotation.

Where the basic main south pole is to the left of the vertical center line, then the commutating pole, if used, will be on the vertical center line. Fig. 1 is used to determine the polarity of commutating pole A. For a motor and clockwise rotation, Fig. 1 shows that the commutating pole A should be of north polarity. For a generator and clockwise rotation, Fig. 1 shows pole A should be of south polarity.

Fig. 1 shows that moving the commutating pole A from the right of the basic main south pole to the left of it, also changes the polarity of the commutating pole A. Thus by using the main south pole as a base, all changes can be governed accordingly.

Brush Polarity

The polarity of the brush on the center line of the top south main pole is found, after the polarity of the main and commutating poles, and their locations are established. Most modern motors use armature winding with the lead pitch of the coils divided equally. The brushes are therefore located on the center lines of the main poles. This means that a main pole of south polarity is always in a position where it can be used as a standard point. See Fig. 1. When a south main pole is used to determine magnetic polarity of the other main and commutating poles, then a south pole should also be used to indicate the brush polarity. That is the polarity of the brush on the center line of the south pole.

It is necessary to know the type of

winding before determining the brush polarity—whether it is lap, wave-progressive, or wave-retrogressive. The progression of the winding determines the flow of current in the armature conductors connected to the brush on the center line of the south pole.

Lap windings are always progressive. In other words, conductors are picked up left to right. With wave windings on four-pole machines, any winding can either be progressive or retrogressive. For machines having more than four poles, the number of bars determines the progression of the winding.

Positive and Negative Brushes on South Pole

With a positive brush polarity on the center line of the basic south main pole, the armature rotation will be clockwise for a lap or retrogressive wave winding, in a motor or generator, as indicated in the tables. For a progressive wave winding and a positive brush on the south pole center line, the armature rotation would be counter-clockwise for both motor and generator.

In the case of a negative brush under the south pole, with a wave progressive winding, the armature rotation would be clockwise, for a motor or generator. With a lap or wave-retrogressive winding, the armature rotation would be counter-clockwise for a motor or generator.

General Tabulation

To simplify the problem, the various factors that govern rotation and polarity can be set forth in tabulated form, as in Tables I and II. In these tables the main pole has been given a magnetic south polarity as the basic starting point. Table I gives the conditions that prevail for clockwise armature rotation. Table II shows the condition that must be met for counter-clockwise armature rotation.

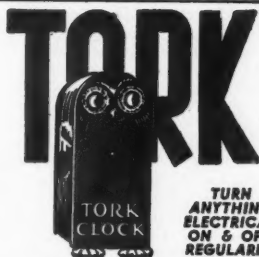
The fourth column in all tables indicates what the polarity of the commutating pole A should be for the commutating pole on the vertical center line of the frame. The fourth column of both tables also shows what the polarity of commutating pole A should be, when the basic south main pole is on the vertical center line of the frame.

A complete winding diagram for field coils can be made up for any motor or generator with Tables I and II and Fig. 1 in this and the preceding article.

When using Fig. 1 to check brush polarity it should be remembered that with a positive brush, the current flows INTO the armature for a motor, and OUT of the armature for a generator.

WHERE TO BUY

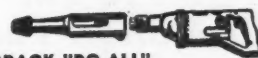
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REGULARLY

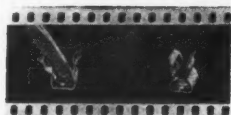
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Telephone AUstin 9866



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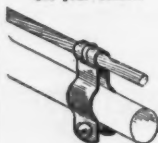
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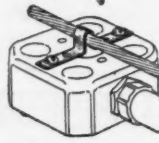
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See your Jobber.



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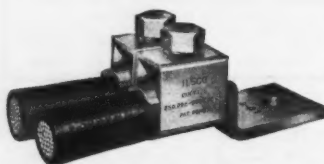
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New York City Office 50 CHURCH ST.
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MULTIPLE CONNECTORS



Big fellows for big jobs:

LU4 for wires from 0 to 350,000 c.m.
LU6 for wires from 250,000 to 500,000 c.m.
Designed for most efficient performance. Simple, accurate, dependable . . . ample contact area for sustained overloads. No special tools required. Quickly installed.



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CINCINNATI, OHIO

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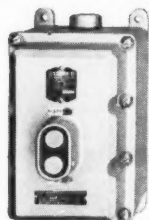
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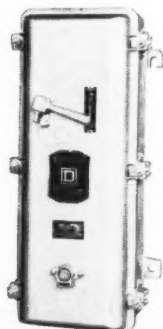
MOTOR CONTROL for use in presence of *Magnesium dust*



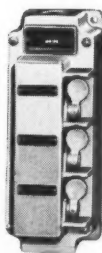
Class 2510 manual starter for motors up to 5 H. P. at 220 volts or 7½ H. P. at 440 volts.



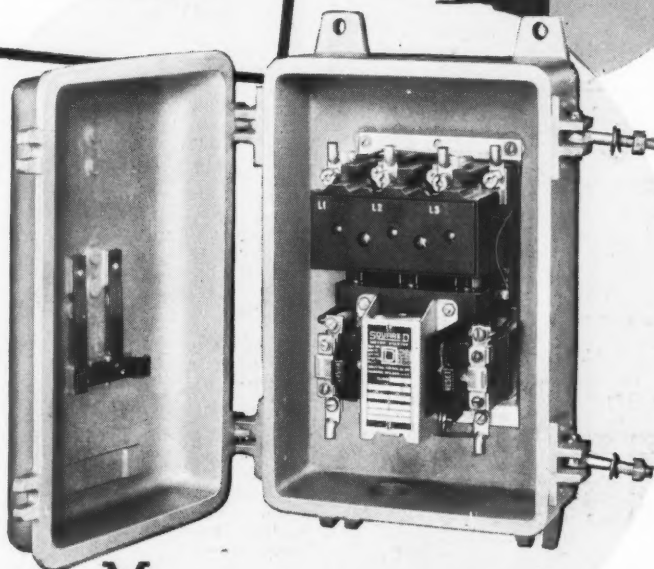
Class 9001, Type BR11 standard duty "Start-Stop" pushbutton station.



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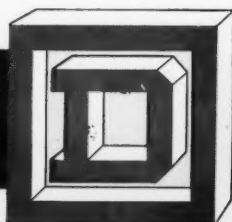


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SQUARE D COMPANY

DETROIT

MILWAUKEE

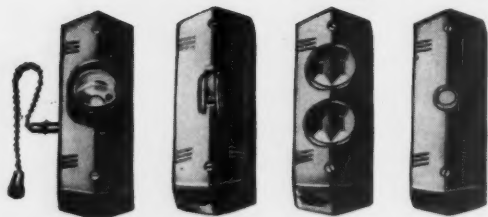
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G-E

TEXTOLITE SOCKETS

Give Lasting Service



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FOR FURTHER INFORMATION about G-E wiring devices, wires and cables and conduits, see the nearest G-E Merchandise Distributor or write to Section CDW-1231-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

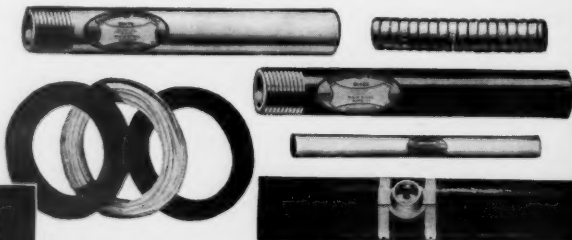
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GENERAL ELECTRIC

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